A TASK ANALYSIS OF MEDICAL LABORATORY WORKERS IN HOSPITALS IN DUVAL COUNTY, FLORIDA

By

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This dissertation is dedicated to
my husband, Donald,
whose encouragement and understanding
made this work possible

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Abstract of Dissertation Presented to the Graduate Council of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

A TASK ANALYSIS OF MEDICAL LABORATORY WORKERS IN HOSPITALS IN DUVAL COUNTY, FLORIDA

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Chairman: Ralph B. Kimbrough
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The purpose of this study was to survey and analyze the types of tasks performed by various levels of medical laboratory technical personnel with the intent of determining what educational background is required for the performance of various laboratory tasks so that recommendations could be made for future curriculum and course development.

The study was concerned with answering the following questions:

1. What are the demographic, educational, and employment characteristics of the various levels of medical laboratory technical personnel in hospitals in Duval County, Florida?
2. What laboratory tasks are performed by the various levels of medical laboratory technical personnel in hospitals in Duval County, Florida?
3. How frequently do they perform these tasks?
4. Where did they learn to perform these tasks?

5. What implications can be drawn from the above questions for future curriculum development for the training and retraining of laboratory workers?

6. Basic to the last question, does there appear to be a need for three distinct educational levels of medical laboratory workers?

A questionnaire was devised and delivered to clinical laboratory personnel in 10 hospitals in Duval County, Florida. Questionnaire responses from 190 laboratory workers were analyzed, and the information formed the bases for this study.

The major findings were divided into demographic, training, and employment characteristics and task performance in the areas of management, teaching, miscellaneous, biochemistry, hematology, urinalysis, serology and virology, parasitology, mycology, nuclear laboratory medicine, bacteriology, and blood bank. There were 69 major findings in the study.

The major conclusions were:

1. There is not a hierarchial arrangement of functions in the clinical laboratory in hospitals in Duval County.

2. For the majority of tasks performed in the laboratory, essentially the same percentage of each of the three educational levels of laboratory workers performed the tasks.

3. The assistants and the technologists, the two categories of workers furthest apart in educational achievement, performed more of the same tasks than any of the other two combinations of workers.

4. When a significant difference did occur between the percentages of two of the categories of workers

performing tasks in the clinical areas, no consistency appeared as to which group performed the more difficult tasks or the tasks requiring a high degree of independent judgment.

5. From the data, it appears that the technicians perform more as generalists in the laboratory while the assistants and technologists are more specialists.

Recommendations were made for curriculum development, laboratory licensing, laboratory restructuring, and for further research.

CHAPTER I

INTRODUCTION

The field of medicine offers tremendous possibilities for the future of mankind. Diseases that once devastated whole empires have virtually been eliminated. The life span of man has been lengthened and his immediate comfort improved due to new discoveries in medicine, and the future holds even more promise. Since World War II progress in automation, new techniques, and new equipment have provided the physician with information about his patient that has increased the accuracy, speed, and reliability of diagnosing and treating diseases.

With the variety of diagnostic tests available now, it is impossible for the physician alone to accept the responsibility for the care of the patient as the general practitioner once did at the beginning of the century. New areas of employment have opened up to help the physician meet the needs of his patients. Today the laboratory worker has become an increasingly responsible and critically important part of the medical team.

Practically all laboratory work done prior to World War I was performed by physicians. As new procedures and tests were developed, the area of laboratory diagnostics (pathology) became large enough for physicians to specialize. Enough physicians were specialists in pathology by 1922 to form the American Society of Clinical Pathologists.

As work loads increased it became the function of the pathologists to train assistants to work in the laboratories. Having assumed the responsibility for teaching, the pathologists, through the American Society of Clinical Pathologists accepted the responsibility of controlling the standards of laboratory personnel by establishing the Registry of Medical Technicians in 1928. (Later, the name was changed to the Registry of Medical Technologists.) There were two categories of laboratory workers registered: the medical technologist who held a university degree with one year of laboratory experience and the laboratory technician who had a high school diploma and six months laboratory experience. In 1933 it was required of all applicants to pass an examination to qualify for registration.

Besides examining and registering laboratory workers, the Registry of Medical Technicians was

initially responsible for compiling a list of schools approved for the training of laboratory workers. In 1936 this function was transferred to the Council on Medical Education of the American Medical Association. In 1949 the duty was returned to the American Society of Clinical Pathologists which established the Board of Schools.

The Board of Schools establishes the course requirements of the academic as well as the hospital portion for approved schools. These requirements must be submitted to the American Society of Clinical Pathologists and then to the American Medical Association for final adoption. Any recommendations for approval or disapproval of a school must also go through these channels for final approval by the American Medical Association.

In 1935 the category of laboratory technician was dropped by the American Society of Clinical Pathologists. However, it was not feasible to attempt to staff the laboratory with only medical technologists. Workers with less formal education had to be employed.

In order to regulate the quality of these workers, in 1963 the American Society of Clinical Pathologists again established a less than college grade category of laboratory worker: the Certified Laboratory Assistant (CLA).

Probably due to the growth of the junior college and the development of the associate degree, there soon appeared in the laboratory a new type of worker—one with more educational qualifications than the CLA yet lacking the requirements for a Medical Technology certification. It became obvious that the qualifications of these workers had to be recognized, so in 1969, the American Society of Clinical Pathologists approved the certification of a third category of laboratory worker—the Medical Laboratory Technician (MLT).

The Medical Technologist, the Medical Laboratory Technician, and the Certified Laboratory Assistant are the main categories certified by the American Society of Clinical Pathologists. There are seven other certifications offered by the Board of Registry of Medical Technology (ASCP) (18), but they are in specific laboratory areas such as the Cytotechnologist—CT(ASCP) and the Nuclear Medical Technologist—NMT(ASCP).

There are other registries for laboratory workers, but the Registry of Medical Technology of the American Society of Clinical Pathologists is the only qualifying board recognized by the American Medical Association (18).

The clinical laboratories in hospitals and independent laboratories are staffed with ASCP certified workers as well as those certified by other registries or workers who hold no certification at all but who are

trained on the job. Although this study will be directed at all clinical laboratory workers regardless of certification, it is intended that the information collected be directed at the improvement of the curriculum for ASCP approved schools for the training of Certified Laboratory Assistants, Medical Laboratory Technicians, and Medical Technologists.

Manpower Needs for the Laboratory

> A critical need for health manpower exists in many communities. In some occupations, such as registered nurse, licensed practical nurse, medical technologists, and a few others, the shortage is nationwide and is generally believed to be worsening. (22:18)

New advances in automation have made a vast number of tests possible. Medicare, Medicaid, as well as prepaid insurance plans have resulted in a greater demand for laboratory services. As a result, there is now a manpower shortage in the laboratory and this shortage is predicted to increase.

Workload predictions were best pointed out by a statement made in *Manpower for the Medical Laboratory*.

> Predictions of laboratory workloads usually start with a base of at least a half-billion clinical diagnostic tests performed in 1966. Projections that this will double by 1975 to at least a billion have been called conservative. The workload in clinical chemistry laboratories has doubled approximately every five years during the past two decades (average increase in tests of 15 percent per year), and this rate of growth is expected to continue.

> In the next 10-15 years, automation is expected to triple or quadruple the capacity of laboratories in general hospitals. However, while automation will bring about increased efficiency per technician hour, most observers agree that these gains usually are offset by requests for a larger quantity of work, resulting in increases in manpower needs. (23:110)

The U.S. Department of Labor (21) predicts an increase of from 40,000 medical technologists in 1966 to 75,000 in 1975. In addition to a growth need of 35,000, 15,000 more medical technologists will be needed to replace those who leave the field due to death, retirement, or for other reasons. Estimated needs for medical laboratory assistants were placed at about 100,000 by 1975. In 1966 about 50,000 were employed. To meet expected needs a total of 70,000 new laboratory assistants would have to be trained by 1975 (growth needs of 50,000, replacement needs of 20,000).

The Manpower Administration of the Department of Labor in a report, *Technology and Manpower in the Health Service Industry, 1965-1975* (22), estimates the number of laboratory workers in 1965 at 100,000 with an additional 27,000 who were working outside of the health service industry. The report predicts the number of workers needed by 1975 at 160,000 within the health service industry and another 43,200 outside the industry for a total of 203,200.

In the report, *Manpower for the Medical Laboratory*, the problem of estimating future manpower needs was

referred to as a "number games" which can confuse as well as mislead:

> Regardless of the amounts, what is obvious is that more manpower is needed now and will be needed in the future, more hands with better education and better training, capable of fulfilling a variety of vital tasks in a variety of settings, all aimed at the fundamental goal of helping the diagnostic team find the hidden causes and cures of diseases. (23:117)

To fulfill these needs for more manpower, steps must be taken to make better utilization of existing manpower as well as to increase the output of newly trained workers. Before any steps can be taken in these directions a thorough analysis of the occupational field of medical technology is needed. No decisions should be made for educational planning without first an in-depth study of what is actually done in a laboratory and what educational level is needed to perform each task. Curricula guidelines then can be constructed for the initial training of laboratory workers and for their continuing education as well.

Purpose of the Study

The purpose of this study was to survey and analyze the types of tasks performed by various levels of medical laboratory technical personnel. The intent of the study was to determine what educational background is required for the performance of various

laboratory tasks so that recommendations could be made for future curriculum and course development.

Statement of Problem

This study was concerned with answering the following questions:

1. What are the demographic, educational, and employment characteristics of the various levels of medical laboratory technical personnel in hospitals in Duval County, Florida?
2. What laboratory tasks are performed by the various levels of medical laboratory technical personnel in hospitals in Duval County, Florida?
3. How frequently do they perform these tasks?
4. Where did they learn to perform these tasks?
5. What implications can be drawn from the above questions for future curriculum development for the training or retraining of laboratory workers?
6. Basic to the last question, does there appear to be a need for three distinct educational levels of medical laboratory workers?

Delimitations and Limitations

The population for this study was considered to be all clinical laboratory workers in hospitals in the state of Florida (with the exception of cytologists and histologists). The sample studied in this survey were all drawn from a single, large county—Duval County. Data were collected only from laboratory workers in hospitals within this county. The laboratory areas of

cytology and histology were not investigated since both usually employ workers with specific training.

Selection of one county out of the whole state was a definite limitation on the study, but it was felt that Duval County was fairly representative of the state of Florida in the number and sizes of hospitals and in the employment and hiring practices concerning laboratory personnel. Selection of one county also allowed the author to be in personal contact with each person receiving a questionnaire, thereby, allowing for the answering of questions concerning the questionnaire and assuring a higher percentage of returns. A mailed questionnaire would undoubtedly have yielded a low return due to the unavoidable necessity of the long questionnaire used in this study.

Need for This Study

The primary justification for this study arose from the need to clarify the occupational tasks of clinical laboratory workers. The vagueness of job duties exists not only among employers but educators and laboratory workers themselves.

Acquisition of information regarding specific job performance should be of use to all those interested in the medical laboratory field.

The need of a complete study of this type is reflected in the first two recommendations made in *Manpower for the Medical Laboratory*.

> Recommendation 1: There is urgent need for a study to determine and define skills and manpower requirements for present and future medical laboratory practice, with consideration of anticipated changes in laboratory methodology, demands for laboratory services, and organization, administration, and delivery of laboratory services.
>
> Recommendation 2: Findings of the study of necessary skills should be employed to reassess and realign laboratory career categories and the educational and technical levels required for the categories. (23:9)

In an article in the *Journal of the American Medical Association* (9), Israel Light, M.D., made this statement: "When developing a new allied health field or a new competency level, it is essential that the *entire* occupation or specialty's job description be scrutinized." As a part of this is required a "thoroughgoing" job or task analysis. Job (or occupational) analysis has long had an honored and strategic place in the administrative, managerial, and supervisory scheme of things in the manufacturing and industrial sectors of our economy. It is all but unheard of in the health field, and its comprehensive introduction in our midst is long overdue."

This study was not an attempt to be the detailed, comprehensive analysis that these two references state is needed. For this, a more extensive,

national survey is required. A start must be made, however, and besides adding to information that can be used on a national basis, it is hoped that this study will be immediately useful to educators and health planners in Florida.

Study Design

This study was an exploratory field study as classified by Kerlinger (8). It had certain strengths and weaknesses. Its strengths included realism, significance, strength of variables, and heuristic qualities. Its weaknesses included its ex post facto nature, the large number of variables, and its difficulties in measurement.

Sample

The sample used in this study was composed of the technical laboratory workers employed in clinical laboratories (with the exception of cytologists and histologists) in the hospitals of Duval County, Florida. It was assumed that Duval County is a fairly adequate representation of the State as a whole.

Instrumentation

The instrument used in this study was developed by the author after comparison with questionnaires used

in similar studies and after consultation with various experts in the clinical laboratory field. A copy of the questionnaire is found in Appendix M. The laboratory tasks listed were compiled primarily from those tasks used in the California task analysis survey (20) and from the recommended list of tasks devised by the Navy (11). The questionnaire included all those clinical tasks which might be performed by a medical laboratory worker excluding those tasks relating to histology and cytology. The survey form provided for responses as to the frequency of performance of the task (routinely, occasionally, rarely) and where the worker first learned to perform the task (in school, on-the-job, continuing education program). Data as to educational background, working experience, and other personal data were also included in the questionnaire.

Data Collection

The data were collected by questionnaires personally delivered to sample subjects at the place of employment. An explanation of the purpose of the questionnaire was given as well as an opportunity to ask any questions. The questionnaires were picked up at the end of approximately three days. If the questionnaires were not completed, the subjects were

reminded of the questionnaire. Repeated trips were made to the hospitals to collect the questionnaires.

The pathologist of one hospital refused to allow his staff to respond to the questionnaire. He first refused because of various wording in the questionnaire. The questionnaire was then redone to meet his specifications. After this, several telephone calls were made by the author, several visits by the Chairman of the Department of Medical Technology at the Florida Junior College at Jacksonville, and two letters were written—one by the author and one by the Chairman of the Medical Technology Department of the University of Florida. No response was made by the pathologist to any of these attempts to have the questionnaires completed.

Exempting this one hospital, there were a total of 208 clinical laboratory workers employed in 10 hospitals in Duval County. A questionnaire was given to each worker.

A total of 190 completed questionnaires (91 percent) were returned. The final sample population consisted of

60 laboratory assistants

29 laboratory technicians

101 laboratory technologists

The 18 laboratory workers who did not respond to the questionnaires were either on vacation, sick, or for various unstated reasons refused to return the questionnaire.

Data Treatment

All data were coded and punched on Indecks® cards and all information retrieved by a manual keysort system. Respondents were grouped according to their educational background, i.e., less than two years of college or CLA certification, two to four years of college or MLT certification, and four years or more of college or MT certification. Written responses to questions were noted on appropriate keysort cards.

Definitions

AMA - American Medical Association. The professional organization of medical practitioners.

ASCP - American Society of Clinical Pathologists. The professional organization of pathologists.

ASMT - American Society of Medical Technologists. The professional organization of medical laboratory personnel. Requirements for full membership include certification by the Registry of Medical Technologists.

Board of Schools - A standing committee of the ASCP consisting of pathologists and technologists for the purpose of inspecting schools and making recommendations for approval or disapproval to the American Medical Association. The Board of Schools also establishes the course requirements of the academic and clinical portions

for approved schools. These requirements must be submitted to the ASCP and then to the AMA for final adoption.

Certification - Professional recognition given to an individual by an organization upon completion of certain educational and/or experience requirements as well as, usually, the passing of a specific examination in the area in which the individual is to be certified.

Certified Laboratory Assistant (ASCP) - A person who has completed high school plus a 12 months' course of practical and technical training in a school approved by the Board of Certified Laboratory Assistants of the ASCP and the ASMT and has passed the examination of CLA given by the Board of CLA; must work at all times under the direct supervision of a medical technologist or a pathologist.

Clinical Laboratory - A place where various tests are performed on human tissues, fluids, excreta, or exudates for the purpose of assisting the physician in the diagnosis, treatment, and management of disease and the maintenance of health.

Laboratory Director - "Any qualified person responsible for administration of technical and scientific operations of a laboratory, including supervision of test procedures and result reporting." (4:10D—41.02.6)

Laboratory Technician - "Any qualified person who functions under the close supervision of a director, supervisor, or technologist and performs only those clinical laboratory procedures which require limited skill, responsibility, and minimal exercise of independent judgement." (4:10D—41.02.9)

Laboratory Worker - One who works in a clinical laboratory performing or supervising the performance of laboratory tests.

Licensure - A legal action for public protection by which a specified status is given to an individual who meets certain qualifications. Licensure for laboratory workers is compulsory in Florida under the Florida Clinical Laboratory Law, Chapter 483 of the Florida Statutes.

Medical Laboratory Technician (ASCP) - A person who requires a limited amount of supervision in performing tests: must have completed two years of education

including supervised clinical experience in an AMA-approved laboratory and passed the examination for Medical Laboratory Technicians given by the Board of Registry of Medical Technologists of the ASCP.

Medical Technologist - "Any qualified person who performs tests which require the exercise of independent judgment and responsibility with supervision by the director or supervisor." (4:10D - 41.02.8)

Medical Technologist (ASCP) - A medical technologist who has completed four years of college which includes not only certain minimum requirements as established by the Board of Registry of Medical Technologists of the ASCP but also a year of clinical experience in a hospital educational program approved by the AMA; must also have passed an examination in medical technology given by the Board of Registry.

Pathologist - A physician who besides his basic medical training has had four to five years of pathology residency. "Adapting the knowledge and techniques of biology, chemistry, and physics to laboratory examinations, the pathologist works with the attending physician to identify a patient's disease and to evaluate effective treatment, solving clinical problems and assessing the significance of laboratory findings." (19:5)

Proprietary (Commercial) School - A school that relies primarily on the tuition of students for its financial support; not eligible for AMA approval for the instruction of laboratory workers.

Registry of Medical Technologists - A standing committee of the ASCP for the purpose of examining and registering laboratory workers.

Supervisor - "Any qualified person who, under general supervision of a director, supervises technical personnel, performs tests requiring special scientific skills, and, in the absence of the director, is held responsible for proper performance of all laboratory procedures and the reporting of results." (4:10D - 41.02.7)

The Organization of This Study

The first chapter of this study presents an introduction to the subject under examination, a

discussion of the need for the study, and a statement of the study's purpose and objectives. Chapter II reviews selected related literature and various similar research studies.

The third chapter presents general background information on the surveyed clinical laboratory workers in Duval County. Chapter IV presents the data on these workers concerning the various tasks performed in the laboratory.

The fifth chapter is a summary of the findings of the survey, a discussion of conclusions based on the data collected in the study, and a presentation of various recommendations for curriculum development, laboratory licensing and restructuring, and for further research.

CHAPTER II

REVIEW OF LITERATURE

In 1956 an ad hoc joint committee of the ASCP and ASMT, the Medical Technology Study Committee, met to discuss various aspects of medical technology (14). A recommendation was made that the National Committee for Careers in Medical Technology do a national study of the education and utilization of medical laboratory personnel. It was not until 1959 that the NCCMT obtained the funds for a pilot study on medical technology education in Alabama. This was known as the "Alabama Pilot Study" and later the Alabama Project (3). It consisted of three phases which assembled information on current educational programs in schools of medical technology, made recommendations for improvements, established a newsletter to facilitate communication between schools, and provided for an evaluation of all project activities.

In 1962 representatives of agencies concerned with medical technology education met to study the findings of the Alabama Project. A result of the meeting was a recommendation that a pilot study be made to test whether or not a central educational center could be established

that would operate for all approved schools of medical technology as the Alabama Project had for the Alabama schools. As a result, in 1964 the National Council on Medical Technology Education was established.

One of the first recommendations made by NCMTE was the future study of present baseline needs of medical technology education. One of its first projects was an extensive study of medical technologists (14).

Done in 1967, the study entitled, *National Correlations in Medical Technology*, had as its purpose to "examine the relationships between educational preparation and job performance of laboratory personnel" (14:90). The sample surveyed consisted of 1,861 medical technologists who had filed for the July, 1962 Medical Technology (ASCP) examination. The primary objective was to determine the relationship among job performance, certification, examination score, and preclinical and clinical study grades. The survey questionnaire sent to the medical technologists consisted of 16 questions calling for about 50 responses. Supervisors of the technologists surveyed were sent two questionnaires: one for evaluation of the performance and knowledge of the technologist and the other a personal inventory of experience, training, and education.

One of the main conclusions reached in the study was that an educational curriculum leading to a degree in

medical technology provided a more adequate preparation for work in the profession than did any other curriculum. Statistically more technologists who possessed a degree in medical technology passed the MT (ASCP) examination than did those with or without other degrees.

Part two of the Project 1 initiated by the National Council on Medical Technology Education was *Report of a National Study of Cytotechnologists: Education and Performance Relationships* (15). The sample surveyed consisted of 358 cytotechnologists who had taken the 1965 certification examination in exfoliative cytology administered by the Board of Registry of Medical Technologists (ASCP). Of the 358 questionnaires sent out, 249 (70 percent) were returned. Besides the information on the questionnaires, the cytotechnologist's school grades were obtained and questionnaires were sent to the technologist's present supervisor for evaluation of work performance of the cytotechnologist.

There was statistically significant evidence to support the conclusion that preparation in an AMA-approved school of cytotechnology is more successful in preparing cytotechnologists to pass the certification examination than is other preparation. There was no statistically significant differences between job performance as rated by supervisors and the passing or failing of the certification examination. Although this study is not directly

pertinent to the present study, it has been included as one of the few related studies available.

Dean S. Ammer, working under a U.S. Public Health Service grant, surveyed seven hospitals in Boston studying the working patterns of hospital laboratory workers (1). The basic objective of the study was to "create a statistically valid computer simulation of a lab and then to vary critical imputs as well as demand" (1:v). He was not able to accomplish this task since, as the author states: "The simple fact is that laboratory technicians spend about 80 percent of their time on activities that cannot be directly related to any useful output" (1.v).

Ammer attempted in his investigation to compare a hospital laboratory to an industrial engineering plant, trying to relate both on the same standards of efficiency, production, and output. He found this difficult to do, but placed the blame on the laboratory instead of his techniques. Much criticism could be made of this latter, as no one on his staff used to conduct the study was in any way familiar with hospital laboratory procedures or methods. The author's own ignorance on the subject is evident throughout his report in his attempted explanations of functions within the laboratory, as well as his confusion with the professional organizations associated with clinical laboratories and his misuse of the word, "technicians."

Ammer's study was essentially a time- and motion-analysis of hospital laboratories. A total of 300,000 observations were made of about 200 laboratory workers for the equivalent of about 400 working hours. The procedure was for an observer to be located within a certain room and every hour at a predecided time which varied, the observer would record the activity of all laboratory personnel for whom he was responsible. The activities were listed in gross categories such as talking, recording data, observing, etc. If the laboratory worker was not in the room he was recorded simply as "out" with no further explanation as to whether or not the worker was actually working, i.e., perhaps drawing blood, or out to lunch.

Throughout his report, Ammer hinted at the lack of a need for technologists as opposed to technicians, although his categories were so gross that it is hard to distinguish one from the other. The following is an example of Ammer's approach:

> Educators——especially those associated with ASCP medical technology programs promote more rigorous standards even if this has the side effects of restricting supply and raising costs. Their argument, like the others presented above, has merit. But it also overlooks the fact that major quality failures in the lab are usually the product of such common human failures as clerical errors or plain simple laziness. These shortcomings are certainly not unknown among such a highly educated group as college professors! And we saw no evidence that they are more prevalent among technicians who graduated from a "quickie"

> course that teaches them how to perform tests by rote without understanding their substance than they are among those who hold B.S. or M.S. degrees." (1.24)

There is little wonder Ammer saw no evidence of the frequency of quality failures among laboratory workers since he did not study such errors.

Another fallacy in his conclusions is his attempt to equate quantity with quality, an area he did not study. One suggestion Ammer makes to save money and to solve the manpower shortage is to cut down on the number of technologists employed in a hospital.

> This assumes of course that the quality and quantity of the work performed by the ordinary technician is equal to that of the technologists. This appears to be more than half true. Quantitative data gathered in this study prove that there is no significant difference between the working patterns of technicians and technologists. (1:13)

This "assumes" a great deal more than Ammer set out to prove, or indeed, even investigate.

Horowitz and Goldstein in 1968 did a study of selected paramedical occupations financed from a grant from the Manpower Administration, U. S. Department of Labor, under the authority of the Manpower Development and Training Act (7). The study was primarily for testing the hypothesis that hiring standards of hospitals were higher than were actually needed for the duties performed with the result that many paramedical jobs were not filled.

The study was conducted in 20 hospitals in the Greater Boston Area covering 22 paramedical occupations and 524 workers. Included in the occupations studied were laboratory personnel. A total of 146 technologists and technicians were included in the sample. The questionnaire included major job functions performed by the laboratory worker and the time spent on these functions. The job functions were ranked according to complexity in terms of specific training or education.

Horowitz and Goldstein concluded from their study that there is little difference between technologists and technicians in what they do and how they spend their time. However, the division between technologists and technicians was somewhat vague. Over 86 percent of the technologists had at least an Associate of Arts degree while only 7.2 percent of the technicians had achieved this level or higher. Only 18.3 percent of all the workers were MT (ASCP).

The authors state:

> The vast majority of Technicians perform the very same tasks as the Technologists in their field. However, far more time and effort are devoted to the education and professional training of the Technologists. The Technician, with a good deal less education and professional training, is performing adequately on the job. (7:30)

The authors go beyond their study when they make this last statement, as no evaluation as to the adequacy of

performance was made during the study. This overextension of the survey was found throughout the study. In their general conclusions covering all the paramedical occupations, the authors make the following statement:

> Our findings indicate that widespread shortages exist in many paramedical occupations. The findings also indicate that personnel of widely different educational and professional backgrounds are employed to perform the same or similar paramedical tasks. We conclude from this that in a number of paramedical occupations, persons with considerably less than the current average of education and professional training can and do perform the work satisfactorily. (7:xi)

A study by Harkness, Cadmus, and Tillman, *A Manpower Study of Technical Personnel in Hospital Clinical Laboratories* (5) was done in 1968 under a grant from the U. S. Department of Labor under the authority of the Manpower Development and Training Act. The authors sent survey forms to 160 short-term hospitals in North Carolina. One hundred and fifty-six hospitals responded from which 199 laboratory workers were selected and interviewed. Of these workers, 148 received specimens of unknown determination on which various tests were to be performed. Returns were received from 114, a 77 percent return. The accuracy of these results were then noted after grouping the laboratory worker according to the size of the hospital in which he was employed. Included in the survey of the hospital laboratories was the total number of tests performed per laboratory and per patient.

From this review of the number and quality of laboratory procedures, the authors list four general conclusions:

1. Regardless of hospital size, laboratory operation, supervision, equipment, and personnel training, each hospital laboratory performs the same ratio of tests per bed.

2. Regardless of hospital size and the other factors mentioned above, each hospital has the same ratio of workers per bed.

3. Most measures of quality of laboratory performance (regardless of worker's skill, experience, supervision, etc.) indicate that, as hospital size increases, so does the quality of the work performed.

4. There is an indication that, if automated laboratory methods became efficient and more prevalent, then output/bed will increase and worker/bed will decrease because the areas of lab most easily automated make up 7/8 of the total output. (5:10)

The authors rated the results of the unknowns on an accurate, minimal, and inaccurate scale. In all cases the small hospital (99 beds and under) rated less than 1/2 the medium and less than all large hospitals (over 300 beds) in terms of quality of total performance. In chemistry alone 51 percent of all determinations on the unknowns in the small hospitals were found to be inaccurate.

Although almost 85 percent of the workers in the smaller hospitals were trained in commercial schools or on the job, the authors concluded that supervision is the determining point in quality performance. The medium-sized hospitals were considered the "meeting ground" of the

advanced trained (the MT (ASCP)) and the more quickly trained worker (the commercial school graduate and the on-the-job trained worker). Although again, as in the case of the small hospitals, the data indicated that those medium sized hospitals that rated lower in laboratory quality had a lower percent of workers with advanced training, the investigators still concluded that this difference in quality was more dependent on supervision than on training per se:

> Under certain supervisory situations, workers with different degrees of training work together effectively and produce accurate and reliable results; in other situations in which supervisory direction was weak or pathological coverage was ineffective, any mixture of workers with varying degrees of ability always produced lower quality output.
>
> The indication that the 'mixture' of workers (under correct supervision with continuing on-the-job training) is effective suggests that larger hospitals could gradually fill severe manpower deficiencies by employing quickly trained (or untrained) workers and bringing them up to a higher standard of performance through on-the-job training. (5:48)

In 1968, the National Committee for Careers in Medical Technology did a study on the Laboratory Assistant. This study, *Final Report: Laboratory Assistant Field Project* (12), was funded by the Manpower Administration, U. S. Department of Labor, and was the larger portion of a study entitled *Work Experience of Certified Laboratory Assistants* (13). Questionnaires were sent out to all 3,282

CLA who had been certified from 1965 (the beginning of CLA certification) until the time of the survey, May, 1968. A total of 160 CLA schools were included in the study that initially was started to study the disadvantaged. The questionnaires used in the initial project drew only 970 responses, about 30 percent. The purpose of the five-question questionnaire was to relate CLA training to actual work experience.

The larger study comprised several parts including a study of the curriculum offered in the schools, a training guide, the development of demonstration projects as well as the study of the disadvantaged trainee and an investigation of methods of predicting success for CLA trainees.

The survey of laboratory assistants indicated that many CLAs work independently all of the time and many most of the time. Night call and weekend work is often done without any assistance, although in emergencies a medical technologist or pathologist is available for call.

> A few, however, are in charge of departments or are the chief or only technician in a small hospital or private laboratory with no direct supervision. Some of these, of course, are the older people who have worked 3 to 25 years in the same laboratory, following on-the-job training. Others are recent CLA graduates working in sparsely-settled areas where hospital administrators and physicians are delighted to hire someone with even this level of approved training. And sadly enough many work in such

> positions in large cities because of the acute shortage of laboratory manpower. (12:31)

Regardless of the reason, these CLAs who are working without supervision are going beyond the scope of their preparation which was intended to cover areas and procedures to be done only under the direct supervision of a medical technologist or pathologist and, hence, represent an improper utilization of CLA workers.

The most recent task analysis performed on clinical laboratory personnel was done in June, 1971, by Howard Taub at the University of California, financed by a grant from the U. S. Office of Education (20). The project entitled, "A Study of the Medical Laboratory Occupations," surveyed 224 clinical workers in 29 hospitals and independent laboratories in six large metropolitan cities. Forty-two percent of the respondents were from California, a state which by licensure law, does not utilize the CLA or MLT (18).

Respondents were divided into two main categories: certified (Medical Technologist (ASCP) or Clinical Laboratory Technologist by California registry) or non-certified (held no certification). These two groups were further subdivided into two classifications: Specialists or Generalists. A Specialist reported one area as his major responsibility and worked in no more than one other area. A Generalist reported working in more than two clinical areas as his major responsibility.

The purpose of the study was to provide information on the various tasks performed by these four classifications of workers for future use in curricula development especially with reference to the Associate degree level.

Data were reported on each classification of worker performing a particular task. A total of 530 laboratory and management tasks were listed in the questionnaire, 10 percent of which were performed by 50 percent or more of the respondents. Recommendations were made that a nucleus of high performance tasks be used for formulating instructional units. There was no suggestion as to division of tasks to be taught at each of the three main educational levels of medical laboratory worker.

The U. S. Navy has presently completed two years of a five-year study of critical tasks of clinical laboratory personnel in the Services (16, 11). The Committee for Careers in the Medical Laboratory is also presently working on a task analysis of laboratory workers to be completed by 1973 (6). These studies will do much to adequately define tasks in the medical laboratory. However, little information is available now to guide educational planning in this area. It is hoped that this study will fill a gap until such time as a more comprehensive analysis is available.

CHAPTER III

GENERAL BACKGROUND CHARACTERISTICS OF CLINICAL LABORATORY WORKERS

The purpose of this chapter is to present certain data collected from 190 clinical laboratory workers in hospitals in Duval County, Florida. These data and the data in the next chapter should be examined in the light of their potential use in developing an instrument for analyzing the existing educational offerings for laboratory workers in the state of Florida as well as for future licensing revision or laboratory restructuring.

The survey instrument in this study was divided into three parts to facilitate data presentation and interpretation. The data have been categorized by the type of laboratory worker providing the information. Division of laboratory worker into assistant, technician, and technologist was decided by their educational background or ASCP professional certification. The worker classified as assistant has had less than two years of college work or is a Certified Laboratory Assistant (ASCP). The laboratory technician has had two to four years of college or is

certified as a Medical Laboratory Technician (ASCP). The technologist has had at least four years of college or is certified as a Medical Technologist (ASCP).

Part I of the questionnaire consisted of general background information. For ease of presentation, the questions can be divided into demographic, training, and employment characteristics.

Demographic Characteristics

Table 1 presents the demographic characteristics of age distribution and sex among the three types of laboratory workers. For all three levels of workers, over 75 percent of the workers are under 40 years of age with over 50 percent of the workers in the age range of 20 to 29. The ages of the respondents ranged from 17 to 62 years with a mean of 29.6 years.

There is a larger number of female laboratory workers than there are males. This is true for all three levels of laboratory workers. Traditionally, there has been a predominance of women in all the allied health professions. This has mainly been accounted for by the relatively low salaries in these occupations. There has been a trend recently, however, to increase the income of these groups and as a result more men are entering health fields. A higher percentage of males are entering as assistants and technicians rather than as technologists.

TABLE 1

Age Ranges and Sex of the Three Types of Laboratory Workers

	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent
Age Range								
Under 19	4	7	-	-	-	-	4	2
20 - 29	32	53	21	72.4	58	57	111	58
30 - 39	14	23	5	17.2	24	24	43	23
40 - 49	6	10	3	10.4	14	14	23	12
50 - 59	-	-	-	-	2	2	2	1
Over 60	1	2	-	-	-	-	1	1
No Response	3	5	-	-	3	3	5	3
Total	60	100	29	100	101	100	190	100
Sex								
Male	22	36	12	41	20	20	54	28
Female	37	62	17	59	81	80	135	71
No Response	1	2	-	-	-	-	1	1
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

This can probably be explained by the military training program for laboratory technicians. After having been trained by one of the armed services, many of the men are entering into laboratory work either full time, or even more often, into night and weekend part-time jobs.

Table 2 shows the marital status and yearly salary distribution among the three types of laboratory workers. For all three levels of workers, well over half of the respondents are married. Salary distribution is as would be expected with the lower educational level earning less and the higher level earning the most. A high percentage of assistants (41 percent) earn less than $5,400 a year. Over 50 percent of the technicians earn from $5,400 to $7,200 a year and over 70 percent of the technologists earn over $7,200 a year.

Training Qualifications

Tables 3, 4, 5, and 6 present data concerning the training qualifications of the laboratory workers surveyed. Table 3 represents the highest level of formal education achieved by each division of laboratory worker. This was the primary means by which the division of the laboratory workers into categories was made. The 11 workers who were classified as technologists who did not have a bachelor's degree were all ASCP-certified Medical Technologists and, therefore, were grouped with

TABLE 2

Marital Status and Yearly Salary Distribution of the Laboratory Workers

	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Marital Status								
Married	35	58	17	59	66	65	118	62
Single	13	22	9	31	26	26	48	25
Divorced	10	17	3	10	8	8	21	11
Widowed	-	-	-	-	-	-	-	-
No Response	2	3	-	-	1	1	3	2
Total	60	100	29	100	101	100	190	100
Yearly Salary								
Less than $4,000	12	20	4	14	5	5	21	11
$4,000-$4,799	8	14	-	-	2	2	10	5
$4,800-$5,399	4	7	-	-	-	-	4	2
$5,400-$5,999	5	8	2	6	-	-	7	4
$6,000-$6,599	5	8	6	21	-	-	11	6
$6,600-$7,199	2	3	7	24	5	5	14	7
$7,200-$7,999	9	15	-	-	10	10	19	10
$7,800-$11,999	9	15	6	21	63	62	78	41
$12,000 or More	-	-	-	-	10	10	10	5
No Response	6	10	4	14	6	6	16	9
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

TABLE 3

Highest Level of Formal Education of the Three Types of Laboratory Workers

Education	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Less than High School Graduate	3	5	-	-	-	-	3	2
High School Graduate	30	50	-	-	-	-	30	15
Less than 2 Years of College	25	42	-	-	-	-	25	13
Two to 4 Yrs. of College	-	-	29	100	11	11	40	21
Bachelor's Degree	-	-	-	-	87	86	87	46
Master's Degree	-	-	-	-	3	3	3	2
Doctorate Degree	-	-	-	-	-	-	-	-
No Response	2	3	-	-	-	-	2	1
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

the technologists. (In 1968 a degree became a prerequisite for certification.) The two workers in the assistant group who did not specify their highest level of education were ASCP Certified Laboratory Assistants, and, therefore, were grouped with the assistants.

Table 4 shows the subjects' majors for those workers completing their bachelor's degree. The largest number of respondents listed medical technology as their major. Three technologists completed their master's degree. Their majors were biochemistry, zoology, and bacteriology. All the majors for both the bachelor's and master's degree with the exception of one education major were science-related subjects.

TABLE 4

Academic Majors for Those Laboratory Workers Completing Their Bachelor's Degree

Subject	Number
Bacteriology	3
Biology	18
Chemistry	3
Education	1
Medical Technology	50
Pharmacy	2
Physiology	1
Science	4
Zoology	2
Total	84

The type of medical laboratory training completed by the respondents is shown in Table 5. On-the-job training is the primary source of training for assistants. Both on-the-job training and training in junior colleges or vocational-technical centers are equally common among technicians. Technologists primarily received their training in ASCP approved schools (89 percent). As mentioned earlier regarding the laboratory training of men in the military services, 20 percent of the assistants and 24 percent of the technicians listed this as a source of their laboratory training. This is compared to only 3 percent of the technologists.

The three technologists who listed "Other" as the type of laboratory training specified a public health laboratory, a California approved laboratory, and a school of Medical Technology in the Philippines.

Table 6 shows the distribution of professional certification or registration held by the laboratory workers surveyed. Of the assistants, 76 percent held no certification or registration. Of the technicians 52 percent held no certification and 31 percent were certified as Medical Laboratory Technicians (ASCP). Eighty percent of the technologists are ASCP certified Medical Technologists. Considering the three groups as a whole, over 50 percent of the laboratory workers employed in the hospitals surveyed in Duval County are ASCP certified.

TABLE 5

Type of Medical Laboratory Training Completed by Laboratory Workers

	Assistant		Technician		Technologist		Total	
Type of Training	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
None	-	-	-	-	1	1	1	1
On-the-job	29	48	9	31	4	4	42	22
Proprietary Laboratory School	7	12	1	3	1	1	9	5
Laboratory School in Military Service	12	20	7	24	3	3	22	12
Junior College or Vocational-Technical Center	7	12	9	31	-	-	16	8
ASCP Approved School	5	8	6	21	90	89	101	53
American Association of Blood Bank Approved Training	3	5	2	7	2	2	7	4
Other	-	-	-	-	3	3	3	2
Total	63		34		104		201	

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

TABLE 6

Professional Certification or Registration Held by Laboratory Workers

Certified or Registered As	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Medical Technologist (ASCP)	-	-	-	-	81	80	81	43
Medical Laboratory Technician (ASCP)	-	-	9	31	1	1	10	5
Certified Laboratory Assistant (ASCP)	3	5	2	7	-	-	5	3
Medical Technologist (AMT)	6	10	2	7	8	8	16	8
Certificate in Blook Bank (BB, ASCP)	1	2	-	-	-	-	1	.5
Certificate in Microbiology (Amer. Society of Microbiology)	1	2	-	-	-	-	1	.5
Other	3	5	1	3	3	3	7	4
No Certification or Registration Held	46	76	15	52	8	8	69	36
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

Three assistants checked "Others" under the question of certification. They specified the Florida Society of Medical Technology, the Nuclear Medicine Society, and Certification for Laboratory Technicians from West Virginia. (However, the Florida Society of Medical Technology is not a certifying agency.) One technician specified X-ray technician (ARRT), and the three technologists checking "Others" specified the Florida Society of Medical Technology, Research Biochemist Society, and registered Physical Therapist.

Employment Characteristics

Tables 7 through 15 concern employment characteristics of the workers surveyed. Table 7 shows the length of time of employment of the laboratory workers in the hospital in which they were presently working and the length of time employed in the medical laboratory profession. The assistants and the technologists showed approximately similar work records. The technicians had been employed for a shorter period of time. On the whole the length of time employed is relatively short, but this is to be expected considering the mean age of the group is under 30 years.

Whether or not the three types of workers are employed full time or part-time is shown in Table 8.

TABLE 7

Length of Employment of the Three Categories of Laboratory Workers

	Assistant	Technician	Technologist	Total
	Mean in Yrs.	Mean in Yrs.	Mean in Yrs.	Mean in Yrs.
Length of Time Employed in Present Institution	3.77	2.19	3.54	3.35
Length of Time Employed in Medical Laboratory Profession	7.76	4.88	7.31	7.07

TABLE 8

Full Time and Part-time Employment of Laboratory Workers

	Assistant		Technician		Technologist		Total	
Employment	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Full time	47	78	25	86	95	94	167	88
Part-time	13	22	4	14	6	6	23	12
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

Laboratory workers are predominately employed full time. Although all the laboratories surveyed are open 24 hours a day, seven days a week, coverage of the laboratory is usually accomplished by three eight-hour shifts. Part-time workers are often used, however, on weekends. Sixty-one percent of the part-time workers are males. There is a higher percentage of part-time workers among the assistants and technicians than among the technologists. Considering the percentages of males who are part-time workers, this could be explained again by the laboratory training programs in the military services.

In 1967 a law was passed in Florida that all clinical laboratory workers who performed diagnostic tests on human beings or reported the results of such tests had to be licensed by the State of Florida (4). Table 9 shows the level at which the three categories of respondents are licensed. According to the Florida licensing law, the minimum educational requirement for licensure as a supervisor or a technologist is successful completion of two years of academic study. According to the method by which the laboratory workers were categorized in this study, none of the assistants should qualify for licensure as technologist or supervisor. Twenty-two percent of them do, however, hold one or the other of these licenses. The licensure law requires that all of the respondents to this survey (with the exception of two assistants who reported

TABLE 9

State License Held by the Three Levels of Laboratory Workers

License	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Laboratory Technician	29	48	17	59	1	1	47	25
Medical Technologist	9	15	5	17	71	70	85	45
Supervisor	4	7	1	3	14	14	19	10
Laboratory Director	-	-	-	-	3	3	3	1
Not Licensed in Florida	15	25	4	14	12	12	31	16
No Response	3	5	2	7	-	-	5	3
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

their job as phlebotomists) be licensed. Sixteen percent, however, reported that they held no license. Although, in essence, these people are practicing illegally, there were no funds allotted by the State Legislature for enforcing this law. Until such time as provisions are made for inspection of laboratories, a great number of workers will probably continue to be unlicensed.

Table 10 shows the areas of major responsibility indicated by the surveyed workers. For all three levels of laboratory workers, biochemistry and hematology were the two departments most frequently listed as the area of major responsibility. This is not unexpected since the largest number of tests in any general hospital is ordered in these two areas.

The areas of responsibility specified under "Others" for assistants were phlebotomy—2, administration, out-patient clinic, and toxicology. Those specified by the technologists were cytotechnology, research, teaching—2, and administration—2.

The laboratory workers were asked to check the title that most nearly described their present position. The results are shown in Table 11. The technicians largely held jobs as laboratory technicians (59 percent) although 10 percent were in supervisory positions. The assistants, on the other hand, reported their positions primarily as technicians, but with 22 percent reporting their positions as technologists or higher. Thirty-three percent of the technologists held positions as technologists while 30 percent reported holding supervisory positions.

The workers were asked if they had a pathologist who was available for consultation. All of the workers answered in the affirmative. Table 12 shows the response when the laboratory workers were asked about the

TABLE 10

Areas of Major Responsibility Indicated by the Three Levels of Laboratory Workers

Area	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Bacteriology	6	10	5	17	19	19	30	16
Biochemistry	20	33	16	55	42	42	78	41
Serology	7	12	3	10	20	20	30	16
Hematology	24	40	13	45	33	33	70	37
Mycology	1	2	2	7	3	3	6	3
Parasitology	8	13	3	10	11	11	22	12
Virology	1	2	1	3	2	2	4	2
Urology	11	18	7	24	9	9	27	14
Blood Bank	3	5	7	24	7	7	17	9
Nuclear Medicine	4	7	-	-	7	7	11	6
General (Rotate)	9	15	4	14	18	18	31	16
Other	5	8	-	-	6	6	11	6
Total	99		61		177		337	

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

TABLE 11

Position Held by the Three Levels of Laboratory Workers

Title	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Laboratory Asst.	14	23	2	7	1	1	17	9
Trainee or Student	1	2	1	3	1	1	3	2
Lab. Technician	22	36	17	59	1	1	40	21
Med. Technologist	6	10	6	21	34	33	46	24
Section Supervisor	4	7	3	10	22	22	29	15
Asst. Section Supervisor	2	3	-	-	-	-	2	1
Teaching Supervisor	-	-	-	-	2	2	2	1
Chief Technologist	1	2	-	-	7	7	8	4
Lab. Director	-	-	-	-	1	1	1	1
No Response	10	17	-	-	32	32	42	22
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

TABLE 12

Availability of Pathologist to Laboratory Workers

Availability	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
In Lab at All Time	27	45	17	59	45	48.5	93	49
Available When Needed	22	36	7	24	46	45.5	75	40
Available by Phone	4	7	4	14	4	4	12	6
Not Always Available When Needed	-	-	-	-	-	-	-	-
No Response	7	12	1	3	2	2	10	5
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

pathologists' availability to the laboratory. Eighty-nine percent of the respondents replied that the pathologist was in the laboratory at all times or was available when needed. No laboratory worker reported that the pathologist was not always available when needed.

The laboratory workers were also asked if they worked under the supervision of another laboratory worker. Table 13 shows their response to this question. Both State

TABLE 13

Response to Question: "Do You Work Under the Supervision of Another Laboratory Worker or Supervisor?"

	Assistant		Technician		Technologist		Total	
Response	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Yes	54	90	23	79	87	86	164	86
No	6	10	5	17	14	14	25	13
No Response	-	-	1	4	-	-	1	1
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

licensure and ASCP certification specify that assistants and technicians should at all times work under the supervision of a technologist or physician. Ten percent of the Assistants and 17 percent of the technicians responded that they

do not work under the supervision of another laboratory worker.

The respondents were then asked, if they answered "yes" to the question of working under the supervision of another worker, to check which title best represented the other worker's position. The results from this question are shown in Table 14. The majority of all workers (62 percent) stated that they worked under the supervision of a section supervisor or the chief technologist. Four percent of the workers, however, stated that they worked under the supervision of a technician.

TABLE 14

Position Held by Laboratory Workers Under Whom the Respondents Worked

Position	Assistant		Technician		Technologist		Total	
	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Medical Lab. Technician	2	3	3	10	2	2	7	4
Medical Technologist	16	26	5	17	7	7	28	14.7
Asst. Section Supervisor	1	2	-	-	2	2	3	1
Section Supervisor	13	22	8	28	41	40	62	32.6
Chief Technologist	19	32	8	28	30	30	57	30
Director or Pathologist	1	2	-	-	4	4	5	3
No Response	8	13	5	17	15	15	28	14.7
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory workers, and are based on the total number or respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

The ability to exercise independent judgment in the performance of duties is, according to the Florida Licensing Law and ASCP certification, restricted for both assistants and technicians. When asked if they felt they had the responsibility to use independent judgment in the performance of their duty, 95 percent of all the workers responded in the affirmative. This is shown on Table 15.

TABLE 15

Response to Question of Ability to Exercise Independent Judgment

	Assistant		Technician		Technologist		Total	
Response	No.	Percent*	No.	Percent*	No.	Percent*	No.	Percent*
Yes	55	92	27	93	99	98	181	95
No	2	3	1	3.5	-	-	3	2
No Response	3	5	1	3.5	2	2	6	3
Total	60	100	29	100	101	100	190	100

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

Only three percent of the assistants and technicians felt that they were restricted in their freedom to exercise independent judgment.

Summary

The purpose of this chapter was to present the general background information of demographic, training, and employment characteristics that was obtained from the responses of 190 surveyed laboratory workers to Part I of the Duval County Task Analysis Survey Questionnaire. The characteristics were examined with reference to the three educational levels of the respondents in order to show differences or similarities among assistants, technicians, and technologists. Many characteristics were examined also in reference to the Florida Licensing Law and to requirements for ASCP certification.

CHAPTER IV

THE LABORATORY TASKS PERFORMED BY CLINICAL LABORATORY WORKERS

The purpose of this chapter is to present the task analysis data collected from 190 clinical laboratory workers in hospitals in Duval County, Florida. The data in this chapter are compiled from Part II and Part III of the survey questionnaire. Part II is concerned with managerial, teaching, and miscellaneous tasks performed by laboratory workers. Part III is divided into nine clinical areas: biochemistry, hematology, urology, serology and virology, parasitology, mycology, nuclear laboratory medicine, bacteriology, and blood bank.

The laboratory workers were asked to check all tasks that they performed regardless as to how rarely they performed that task. For each task checked they were then asked to check how frequently that task was performed (routinely, occasionally, rarely) and where they learned to perform the task (school, on-the-job, continuing education program).

Ten Tasks Performed by the Highest Percentage of Workers

There was a total of 426 tasks performed by the laboratory workers in this study. The 10 tasks performed

by the largest percentage of technologists were selected and ranked 1 through 10. The performance rank for these tasks were then determined for the assistants and the technicians. The results are shown in Table 16. Six of the 10 tasks performed by the most technologists were in the top 10 tasks performed by both assistants and technicians. Eight of the tasks were found in the top 20 of the tasks performed by assistants and technicians. None of the 10 tasks performed by the technologists is a diagnostic test. All 10 tasks require a minimum degree of training and education and very little use of independent judgment.

Managerial, Teaching, and Miscellaneous Tasks

Managerial Functions

There were 52 tasks listed under managerial duties. None of these tasks was performed by 50 percent or more of the three levels of laboratory workers.

Consultation with several professionals in the medical technology field resulted in the acceptance of a 10 percent difference as a significant level of acceptance of variance between the percentages of laboratory workers performing a particular task. Any difference of more than 10 percent between two or more of the levels of laboratory workers is considered a significant variance from what would normally be expected.

TABLE 16

Ten Tasks Performed by the Most Technologists with Rank Performancy for Assistants and Technicians

Task	Rank Order for Technologists	Rank Order for Assistants	Rank Order for Technicians
Prepare Reagents	1	16	7*
Collect Specimens from Patients	2	1	1
Prepare and Process Specimens	3	9.5*	2.5*
Communicate Laboratory Findings to Physicians	4	4.5*	15.5*
Prepare Solutions and Standards	5	47	21
Log Incoming or Outgoing Specimens	6.5*	18	34.5*
Calibrate Instruments	6.5*	47	34.5*
Draw Capillary or Venous Bloods for Nematology	8.5*	7*	2.5*
Draw Blood Specimens for Chemistry	8.5*	2	7*
Prepare and Stain Blood Smears	10	7*	7*

*When more than one task had the same rank order, the average rank number was used.

Of the 52 tasks listed under managerial functions, 19 tasks (37 percent) differed significantly by more than 10 percent between the percentages of two or more of the levels of laboratory workers performing the task (see Table 17). For eight tasks performed (15 percent), there was a significant difference between the percentages of assistants and the percentages of technicians performing the tasks, the higher rate of performance for all but two cases being by the technicians. Twelve tasks (23 percent) were performed by significantly more technologists than assistants. There were 10 tasks (19 percent) that differed significantly by more than 10 percent between the technologists and the technicians. In all but one of these there was a larger percentage of technologists performing the task.

In frequency of performance of tasks, 36 tasks (69 percent) were checked by 50 percent or more of the workers performing the tasks as being performed routinely. Five tasks (10 percent) were checked by 50 percent or more of the workers performing the tasks as being done occasionally. For nine tasks (17 percent) the greatest percentage of workers performing the tasks was divided between routinely and occasionally, but with 80 percent or more of these workers checking one or the other of these two frequencies. The task, "establish research procedures," was checked as

TABLE 17

Managerial Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Assign Personnel to Duty Positions	19	32	5	17	30	30
2. Assign Space for Equipment and Supplies	14	23	12	41	37	37
3. Develop and/or Improve Work Methods	14	23	12	41	39	39
4. Develop and/or Improve Laboratory Procedures	14	23	10	34	37	37
5. Develop or Revise the Organization of the Section	7	12	6	21	27	27
6. Establish Performance Standards	11	18	3	34	19	19
7. Establish Procedures for Special Tests	17	13	5	17	25	25
8. Establish Quality Control Functions	12	20	9	31	34	34
9. Establish Work Priorities	9	15	5	17	28	28
10. Plan and Schedule Work Assignments	13	22	3	10	27	27
11. Requisition Supplies	19	32	11	38	44	44

TABLE 17—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
12. Direct Subordinates in the Observance of Safety Practices	13	22	4	14	31	31
13. Resolve Staff Complaints	12	20	3	10	23	23
14. Resolve Technical Problems	14	23	11	38	42	42
15. Evaluate the Accuracy of Routine Reports	11	18	4	14	27	27
16. Recommend Special Corrective Action for Recurring Problems	9	15	5	17	31	31
17. Resolve Personal Problems of Subordinates	12	20	3	10	22	22
18. Interpret Policies and Directives	4	7	5	17	19	18
19. Direct Subordinates in Maintaining Performance Standards	12	20	4	14	34	34

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

being performed routinely or rarely, each of the two frequencies being checked by 40 percent of the workers performing the task. The task, "resolve personal problems of subordinates," was checked as being performed occasionally or rarely by 76 percent of the workers performing the task.

All but one task was checked by over 50 percent of the workers performing the tasks as being learned on-the-job. The one task, "recommend special corrective action for recurring problems," was checked by 64 percent of the workers performing that task as being learned in school.

Appendix A shows the total number and percentages of workers performing the managerial tasks, the percentage of these workers who perform the tasks routinely, occasionally, and rarely, and the percentage of these workers who learned to perform the tasks in school, on-the-job, and in continuing educational programs.

In summary, there were 52 tasks listed under managerial functions. None of these tasks was performed by 50 percent or more of any of the three levels of workers. There were 19 tasks (37 percent) for which there was a significant difference of over 10 percent between the percentages of assistants, technicians, or technologists performing the tasks. For 85 percent of the tasks there

were no significant differences between the percentages of the assistants and the technicians performing the tasks. For 77 percent of the tasks there was no significant differences between the percentages of assistants and technologists performing the tasks. For 81 percent of the tasks there was no significant difference between the percentages of technicians and technologists performing the tasks. At least 70 percent of the workers performing the tasks indicated they performed the tasks either routinely or occasionally for 96 percent of the tasks. Over 50 percent of the workers checked on-the-job as the place the tasks were learned for 99 percent of the tasks.

Teaching Functions

There were 18 tasks listed under teaching duties. Only one was checked by more than 50 percent of any of the three divisions of laboratory workers. The task, "give on-the-job instruction in medical laboratory activities," was checked by 53 percent of the technologists as a duty they perform.

There were five tasks (28 percent) that varied significantly by over 10 percent difference in the percentages of the three levels of workers performing the tasks. The tasks are shown in Table 18. There were two tasks (11 percent) performed significantly by more technicians than assistants, four tasks (22 percent)

TABLE 18

Teaching Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Administer Written or Performance Tests	9	15	5	17	31	31
2. Develop On-the-job Training Materials	4	7	3	10	21	21
3. Give Instruction in Accredited Education Program	-	-	5	17	25	25
4. Give On-the-job Instruction in Medical Laboratory Activities	17	28	11	38	53	53
5. Orient Newly Assigned Personnel	13	22	11	38	31	31

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

performed significantly by more technologists than assistants, and three tasks (17 percent) that were performed significantly by more technologists than technicians.

For frequency of performance of the tasks by the workers who checked that they did the tasks, four tasks (22 percent) were checked by 50 percent or more of the workers as being done routinely and nine (50 percent) of the tasks were checked by 50 percent or more as being done occasionally. There were five tasks (28 percent) for which the greatest percentage of workers performing the tasks was divided between routinely and occasionally, but with over 75 percent of these workers checking one or the other of these two frequencies.

All the tasks were checked by at least 50 percent of the workers performing the tasks as being learned on-the-job.

Appendix B shows the total number and percentage of workers performing the teaching tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing educational programs.

In summary, there were 18 tasks listed under teaching functions. For 89 percent of the tasks there

were no significant difference between the percentages of assistants and technicians performing the tasks. For 78 percent of the tasks there was no significant difference between the percentages of assistants and technologists performing the tasks. For 83 percent of the tasks, there was no significant difference between the technologists and the technicians performing the tasks. For all the tasks (100 percent), over 75 percent of the workers performing the tasks checked that they did the tasks either routinely or occasionally. All the tasks (100 percent) were checked by at least 50 percent of the workers performing the tasks as being learned on-the-job.

Miscellaneous Functions

There were 50 tasks listed under miscellaneous functions. Twenty-four of these tasks (48 percent) were performed by 50 percent or more of at least one of the three educational levels of laboratory workers. Table 19 lists the 24 tasks and the number and percentages of the workers of each category performing the tasks. There were nine tasks (18 percent) performed by 50 percent or more of the assistants, 21 tasks (42 percent) performed by 50 percent or more of the technicians, and 19 tasks (38 percent) performed by 50 percent or more of the technologists.

Thirty-four of the 50 tasks (68 percent) varied in the percentages of the three levels of workers performing

TABLE 19

Miscellaneous Tasks Performed by 50 Percent or More of Any One of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Collect Specimens from Patients	50	83	28	97	83	82
2. Prepare and Process Specimens	39	65	27	90	82	81
3. Inventory and Order Supplies	27	45	17	59	51	51
4. Perform Preventative Maintenance on Lab Equipment	22	37	16	55	58	57
5. Perform Sperm Counts	28	47	16	55	37	37
6. Prepare Reagents	36	60	25	86	85	84
7. Prepare Specimens for Shipment	31	52	16	55	50	50
8. Prepare Standards	26	43	20	69	68	67
9. Operate Analytical Balance	26	43	18	62	67	66
10. Requisition Supplies	21	35	14	48	54	53
11. Communicate Lab Findings to Physicians	41	68	23	79	81	80
12. Explain Lab Findings to Physicians	29	48	19	66	65	64

TABLE 19—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
13. Explain Lab Tasks to Physician	24	40	17	59	53	52
14. Explain Lab Tasks to Hospital Staff	25	42	15	52	56	55
15. Explain Lab Tasks to Patients	28	47	15	52	48	48
16. Determine Equipment Repairs or Replacements Needed	19	32	12	41	54	53
17. Log Incoming or Outgoing Specimens	35	58	20	69	70	69
18. Receive Incoming Supplies	22	37	16	55	48	48
19. Prepare Solutions and Standards	29	48	22	76	75	74
20. Perform Spinal Fluid Cell Counts	31	52	19	66	55	54
21. Perform Cerebrospinal Fluid Counts	30	50	16	55	47	47
22. Perform Occult Blood Test	35	58	22	76	49	49
23. Perform Preventative Maintenance of Lab Equipment	22	37	11	38	65	64
24. Calibrate Instruments	29	48	20	69	70	70

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

the tasks by over 10 percent. These are shown in Table 20. There were 25 of the 50 tasks (50 percent) for which the percentages of assistants performing the tasks varied significantly by over 10 percent from the percentages of technicians performing the tasks. For all 25 tasks there was a greater percentage of technicians performing the tasks than there was of assistants. For 22 tasks (44 percent) there was a significant difference in the percentages of assistants and technologists performing the tasks, with a greater percentage of technologists performing the tasks in all but two of the cases. There were nine tasks (18 percent) for which the percentages of technicians and technologists performing the tasks varied by more than 10 percent. For five of these tasks there was a greater percentage of technicians performing the tasks than technologists.

Fifty-two percent of the tasks (26 tasks) were checked by 50 percent or more of the workers performing the tasks as being performed routinely. Fourteen percent (seven tasks) were checked as being performed occasionally. Ten percent (five tasks) were checked as being performed rarely by 50 percent or more of the workers performing the tasks. There were 12 tasks (24 percent) for which the percentages of workers performing the tasks were distributed so that no one category of frequency was checked by 50

TABLE 20

Miscellaneous Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Collect Specimens from Patients	50	83	28	97	83	82
2. Prepare and Process Specimens	39	65	26	90	82	81
3. Inventory and Order Supplies	27	45	17	59	51	51
4. Perform Electrocardiogram (EKG) Test	15	25	5	17	13	13
5. Perform Preventative Maintenance on Lab Equipment	22	37	16	55	58	57
6. Perform Sperm Counts	28	47	16	55	37	37
7. Prepare Electrophoresis Patterns	15	25	11	38	26	26
8. Prepare Reagents	36	60	25	86	85	84
9. Prepare Specimens for Training or Reference	11	18	8	28	33	33
10. Prepare Standards	26	43	20	69	68	67
11. Read Electrophoresis Patterns	11	18	9	31	23	23
12. Operate Analytical Balance	26	43	18	62	67	66
13. Requisition Supplies	21	35	14	48	54	53

TABLE 20—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
14. Communicate Laboratory Findings to Physicians	41	68	23	79	81	80
15. Explain Laboratory Findings to Physicians	29	48	19	66	65	64
16. Explain Laboratory Task to Physician	24	40	17	59	53	52
17. Explain Laboratory Tasks to Hospital Staff	25	42	15	52	56	55
18. Determine Equipment Repairs or Replacement Needed	19	32	12	41	54	53
19. Initiate Reports on Unsatisfactory Equipment	12	20	9	31	44	44
20. Log Incoming or Outgoing Specimens	35	58	20	69	70	69
21. Maintain Files of Laboratory Records or Reports	20	33	13	45	43	43
22. Purchase Supplies	5	8	7	24	16	16
23. Receive Incoming Supplies	12	37	16	55	48	48
24. Requisition Supplies	18	30	14	48	41	41
25. Prepare Solutions and Standards	29	48	22	76	75	74
26. Perform Spinal Fluid Cell Counts	31	52	19	66	55	54

TABLE 20—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
27. Perform Occult Blood Test	35	58	22	76	49	49
28. Perform Preventative Maintenance on Lab Equipment	22	37	11	38	65	64
29. Calibrate Instruments	29	48	20	69	70	69
30. Assist with Autopsy	10	17	3	10	5	5
31. Establish Procedures for Special Tests	9	15	6	21	28	28
32. Procure and Store Biological Items	6	10	2	7	18	18
33. Use Crystal and Liquid Scintillation Detectors	2	3	4	14	10	10
34. Calculate, Evaluate Quality Control	17	28	12	41	38	38

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

percent or more of the workers. For eight of these tasks, the distribution of the frequency was such that at least 77 percent of the workers performing the tasks checked either routinely or occasionally. One task, "perform sperm counts," was checked by 80 percent of the workers performing the task as being performed either occasionally or rarely. There were three tasks in which the majority of the percentage of workers performing the tasks were split between routinely and rarely.

For 15 tasks (30 percent), school was checked by 50 percent or more of the workers performing the tasks as the place the tasks were learned. On-the-job was indicated for 32 tasks (64 percent) by 50 percent or more of the workers performing the tasks. There were three tasks, "prepare electrophoresis patterns, calibrate instruments, and assist in research assignments," for which the largest percentage of the workers performing the tasks was split between school and on-the-job as the place where performance of the tasks was learned.

Appendix C shows the total number and percentage of workers performing the miscellaneous tasks, the percentages of those workers who perform the tasks routinely, occasionally, and rarely, and the percentage of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 50 tasks listed under miscellaneous functions. Twenty-four tasks (48 percent) were performed by 50 percent or more of at least one of the categories of laboratory workers. For 50 percent of the tasks there was no significant difference between the percentages of assistants and technicians performing the tasks. For the percentages of assistants and technologists performing the tasks, there was no significant differences for 56 percent of the tasks. There was no significant difference in the percentages of technicians and technologists performing the tasks for 82 percent of the tasks. For 82 percent of the tasks, 50 percent or more of the workers performing the tasks checked either routinely or occasionally as the frequency the tasks were performed. The largest percentage of the workers performing the tasks (64 percent) checked on-the-job as the place in which the tasks were taught.

Clinical Area Tasks

Biochemistry Functions

There were 85 tasks listed under biochemistry duties. There were 30 tasks (35 percent) that were checked by 50 percent or more of at least one of the three categories of workers. These 30 tasks are shown on Table 21. There were more tasks (29 tasks) performed by

TABLE 21

Biochemistry Tasks Performed by 50 Percent or More of Any One of the Three Levels of Laboratory Workers

	Tasks	Assistant		Technician		Technologist	
		Number	Percent*	Number	Percent*	Number	Percent*
1.	Draw Blood Specimens	43	72	25	86	68	67
2.	Operate Automatic Analyzer	23	38	17	59	56	55
3.	Operate Colorimeter	28	47	20	69	52	51
4.	Operate Flame Photometer	31	52	20	69	58	57
5.	Operate pH Meter	25	42	13	45	53	52
6.	Operate Spectrophotometer	25	42	17	59	57	56
7.	Perform Acid Phosphatase Test	26	43	17	59	46	46
8.	Perform Serum Albumin Test	26	43	17	59	48	48
9.	Perform A/G Ratio	23	38	17	59	44	44
10.	Perform Alkaline Phosphatase Test	27	45	19	66	49	49
11.	Perform Amylase Test	31	52	20	69	59	58
12.	Perform Bilirubin (Direct) Test	31	52	21	72	62	61
13.	Perform Bilirubin (Indirect) Test	31	52	19	66	59	58
14.	Perform Calcium Test	25	42	20	69	51	51

TABLE 21—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
15. Perform Carbon Dioxide Determinations	27	45	17	59	59	58
16. Perform Chlorides Test	32	53	20	69	59	58
17. Perform Total Cholesteral Test	25	42	18	62	47	47
18. Perform Serum Creatinine Test	26	43	17	59	50	50
19. Perform Glucose Test	33	55	20	69	62	61
20. Perform Glucose Tolerance Test	30	50	16	55	54	53
21. Perform Serum Glutamic Okalacetic Transaminase	26	43	15	52	47	47
22. Perform Lactic Dehydrogenase (LDH) Test	25	42	15	52	47	47
23. Perform Phosphorus Test	24	40	15	52	46	46
24. Perform Potassium Determinations	31	52	17	59	55	54
25. Perform Slide or Tube Test for Pregnancy	27	45	18	62	46	46
26. Perform Total Protein Test	30	50	21	72	52	52
27. Perform Sodium Determinations	31	52	16	55	53	52

TABLE 21—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
28. Perform Blood Urea Nitrogen (BUN) Test	34	57	18	62	61	60
29. Perform Urine Electrolytes Test	20	33	15	52	39	39
30. Separate Blood from Sera	32	53	20	69	64	63

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

50 percent or more of the technicians than were performed by 50 percent or more of either the assistants (12 tasks) or technologists (20 tasks). This is to be expected from the percentages of each of the categories of workers who specified biochemistry as one of the areas of their major responsibility: 55 percent for technicians, 33 percent for assistants, and 42 percent for technologists.

Of the 85 tasks, there were 40 (47 percent) that differed in the percentages of the three levels of workers performing the tasks by more than 10 percent. These are shown in Table 22. The largest difference was between the assistants and the technicians. The percentages between these two levels of workers differed by more than 10 percent for 38 of the tasks (45 percent). In all but three cases more technicians performed the tasks than assistants. The percentage of assistants performing the tasks differed by more than 10 percent with that of the technologists for only four tasks (5 percent). This is surprising since the assistants and the technologists are the furthest separated in educational achievement. For all four tasks the technologists had the larger percentage of workers performing the tasks. There were 25 tasks (29 percent) for which the percentages of workers performing the tasks differed by more than 10 percent between the technicians and the technologists.

TABLE 22

Biochemistry Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

	Tasks	Assistant		Technician		Technologist	
		Number	Percent*	Number	Percent*	Number	Percent*
1.	Draw Blood Specimens	43	72	25	86	68	67
2.	Operate Automatic Analyzer	23	38	17	59	56	55
3.	Operate Volumetric Blood Gas Apparatus	11	18	9	31	22	22
4.	Operate Colorimeter	28	47	20	69	52	51
5.	Operate Distillation Apparatus	8	13	9	31	18	18
6.	Operate Electrophoresis Equipment	17	28	13	45	30	30
7.	Operate Flame Photometer	31	52	20	69	58	57
8.	Operate Spectrophotometer	25	42	17	59	57	56
9.	Perform Acid Phosphatase Test	26	43	17	59	46	46
10.	Perform Serum Albumin Test	26	43	17	59	48	48
11.	Perform A/G Ratio	23	38	17	59	44	44
12.	Perform Blood Alcohol Test	8	13	7	24	7	7
13.	Perform Alkaline Phosphatase	27	45	19	66	49	49
14.	Perform Amylase Test	31	52	20	69	59	59

TABLE 22—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
15. Perform Barbiturate Level Test	12	20	11	38	24	24
16. Perform Bilirubin (Direct) Test	31	52	21	72	62	61
17. Perform Bilirubin (Indirect) Test	31	52	19	66	59	58
18. Perform Calcium Test	25	42	20	69	51	51
19. Perform Carbon Dioxide Determinations	27	45	17	59	59	58
20. Perform Chlorides Test	32	53	20	69	59	58
21. Perform Total Cholesteral Test	25	42	18	62	47	47
22. Perform Total Cholesteral Esters Test	13	22	3	10	19	19
23. Perform Colloidal Gold Curve Test	10	17	9	31	19	19
24. Perform Creatine Test	16	27	11	38	26	26
25. Perform Serum Creatinine Test	26	43	17	59	50	50
26. Perform Glucose Test	33	55	20	69	62	61
27. Perform Glucose-6-phosphate Dehydrogenase Test	8	13	8	28	23	23
28. Perform Icterus Index Test	18	30	5	17	27	27

TABLE 22—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
29. Perform Leucine Aminopeptidase (LAP) Test	16	27	11	38	32	32
30. Perform Lipids Profile Test	10	17	8	28	20	20
31. Perform Phenusulfonphthalein (PSP) Excretion Test	20	33	5	17	27	27
32. Perform Phosphorus Test	24	40	15	52	46	46
33. Perform Urine Prophyrin +/or Porphobilinogen Test	23	38	12	41	30	30
34. Perform Slide or Tube Test for Pregnancy	27	45	18	62	46	46
35. Perform Protein Bound Iodine (PBI) Test	12	20	10	34	18	18
36. Perform Total Protein Test	30	50	21	72	52	51
37. Perform Urinary Calcium Test	15	25	12	41	30	30
38. Perform Urine Electrolytes Test	20	33	15	52	39	39
39. Separate Blood from Sera	32	53	20	69	64	63
40. Teach	7	12	4	14	26	26

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

In all but one of these the technicians had the greater percentage of workers performing the tasks.

For frequency of performancy of the tasks, 30 tasks (35 percent) were checked by 50 percent or more of the workers performing the tasks as being done routinely. There were only two tasks (2 percent) that were checked by 50 percent or more of the workers performing the tasks as being done occasionally. Fifteen tasks (18 percent) were checked by 50 percent or more of the workers performing the tasks as being done only rarely. The remaining 38 tasks (29 percent) had the percentages of workers performing the tasks distributed such that no one frequency was checked by 50 percent or more of the workers. For seven tasks, the greatest percentage (75 percent or more) was distributed between routinely and occasionally. For four tasks, 75 percent or more of the workers performing the tasks checked either occasionally or rarely. The percentages for the other tasks were fairly evenly distributed.

In school was checked by 50 percent or more of the workers performing the tasks for 56 of the tasks (66 percent) as the place the tasks were learned. On-the-job was checked by 50 percent or more of the workers performing the tasks for 21 tasks (25 percent). "Teach" and "supervise biochemistry procedures" were two of the tasks indicated that were learned on-the-job. For eight tasks

(9 percent), the distribution of the percentages of workers performing the tasks was fairly even between in school and on-the-job.

Appendix D shows the total number and percentage of workers performing the biochemistry tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 85 tasks listed under biochemistry functions. Thirty of these (35 percent) were checked by at least one of the three categories as being performed by 50 percent or more of the workers in that category. There were more tasks performed by 50 percent or more of the technicians than there were that were performed by 50 percent of either assistants or technologists. For 45 tasks (43 percent) there was no significant difference in the percentage of workers in the three categories performing the tasks. For 55 percent of the tasks there was no significant difference between the percentages of assistants and technicians. For 95 percent of the tasks there was no significant difference between the percentages of assistants and technologists performing the tasks. For 71 percent of the tasks there was no significant difference between the percentages of

technicians and technologists. Thirty of the tasks (35 percent) were checked by 50 percent or more of the workers performing the tasks as being done routinely. For the next largest number of tasks, 27 (31 percent), the distributions of the percentages of workers performing the tasks were fairly evenly distributed among the three frequencies. In school was indicated for the largest number of tasks, 56 (66 percent), as the place where the largest percentage of workers were taught to perform the tasks.

Hematology Functions

There were a total of 52 tasks listed under hematology duties. Of these 27 (52 percent) were checked by 50 percent or more of at least one of the three categories of workers. These are shown on Table 23. All of these tasks were performed by 50 percent or more of the technicians. Twelve tasks (23 percent) were performed by 50 percent or more of the assistants and 19 tasks (37 percent) by 50 percent or more of the technologists. This was the area indicated by the greatest number of assistants as the area of their major responsibility, and indicated by the second greatest number of technicians and technologists.

There were 34 tasks (65 percent) for which the percentages of workers performing the tasks differed by

TABLE 23

Hematology Tasks Performed by 50 Percent or More of Any One of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Perform Bleeding Time Procedure—Duke method	29	48	20	69	30	30
2. Prepare and Stain Blood Smears	40	67	25	86	67	66
3. Perform Clot Retraction Test	27	45	20	69	47	47
4. Perform Venous Whole Blood Coagulation Time Test	35	58	24	83	51	51
5. Perform Differential Cell Count	29	48	25	86	63	62
6. Perform Eosinophile Count	25	42	16	55	47	47
7. Calculate Erythrocyte Indices	28	47	16	55	42	42
8. Perform Hematocrit Test	38	63	25	86	65	64
9. Perform Hemoglobin Test	37	62	25	86	62	61
10. Identify Morphological Variations of Red or White Blood Cells	27	45	22	76	61	60
11. Perform Partial Thromboplastin Time (PTT) Test	28	47	23	79	50	50

TABLE 23—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
12. Perform Platelet Count	30	50	19	66	49	49
13. Perform Prothrombin Time Test	31	52	22	76	55	54
14. Perform Red Blood Count	29	48	21	72	55	54
15. Perform Reticulocyte Cell Count	29	48	20	69	53	52
16. Perform Erythrocyte Sedimentation Rate	33	55	22	76	55	54
17. Perform Sickle Cell Preparation	29	48	20	69	57	56
18. Perform Spinal Fluid Cell Count	30	50	19	66	48	48
19. Perform White Blood Counts	31	52	24	83	60	59
20. Draw Capillary or Venous Bloods	40	67	26	90	68	67
21. Collect Blood Specimens for Laboratory	42	70	25	86	66	65
22. Identify Immature Blood Cells	21	35	19	66	50	50
23. Determine Coagulation Time by Lee-White Method	41	68	24	83	52	51
24. Perform Thrombocyte Count	20	33	15	52	41	41
25. Operate Automatic Cell Counter	26	43	19	66	52	51

TABLE 23—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
26. Operate Hemoglobinometer	23	38	15	52	41	41
27. Operate Microhematocrit Reader	28	47	23	79	59	58

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

more than 10 percent between two or more of the three levels of workers (see Table 24). For 31 tasks (60 percent) the difference was between the assistants and the technicians with the technicians having the greater percentage of workers performing the tasks. For nine tasks (17 percent) the difference was between the assistants and the technologists with the technologists having the greatest percentage for seven of the tasks. For 28 tasks (54 percent) the difference was between the technicians and the technologists with the technicians having the greater percentage for all but one tasks which was "teaching."

Twenty-three (44 percent) of the tasks were checked by 50 percent or more of the workers as being performed routinely. Only one was checked by 50 percent or more as being done occasionally. Eight (15 percent) were checked by 50 percent or more of the workers performing the tasks as being done rarely. There were 20 tasks (38 percent) for which the percentages of workers performing the tasks were distributed with no frequency having been checked by more than 50 percent of the workers. Six of these were checked as being done either routinely or occasionally by 75 percent or more of the workers performing the tasks and three were checked either occasionally or rarely by 75 percent or more of the workers performing the tasks. The other 11 tasks were checked so

TABLE 24

Hematology Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Perform Bleeding Time Procedures—Duke Method	29	48	20	69	30	30
2. Prepare and Stain Blood Smears	40	67	25	86	67	66
3. Perform Capillary Resistance Test	7	12	7	24	23	23
4. Perform Clot Retraction Test	27	45	20	69	47	47
5. Perform Venous Whole Blood Coagulation Time Test	35	58	24	83	51	51
6. Perform Differential Cell Counts	29	48	25	86	63	62
7. Perform Eosinophile Count	25	42	16	55	47	47
8. Calculate Erythrocyte Indices	28	47	16	55	42	42
9. Perform Hematocrit Test	38	63	25	86	65	64
10. Perform Hemoglobin Test	37	62	25	86	62	61
11. Microscopically Identify Lupus Erythematosus Cells	18	30	13	45	40	40
12. Identify Morphological Variations of Red and White Blood Cells	27	45	22	76	61	60

TABLE 24—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
13. Perform Partial Thromboplastin Time (PTT) Test	28	47	23	79	50	50
14. Stain and Read Peroxidase Stain	6	10	6	21	19	19
15. Perform Platelet Count	30	50	19	66	49	49
16. Perform Prothrombin Time Test	31	52	22	76	55	54
17. Perform Red Blood Count	29	48	21	72	55	54
18. Perform Reticulocyte Cell Count	29	48	20	69	53	52
19. Perform Erythrocyte Sedimentation Rate	33	55	22	76	55	54
20. Perform Sickle Cell Preparations	29	48	20	69	57	56
21. Perform Spinal Fluid Cell Count	30	50	19	66	48	48
22. Perform White Blood Counts	31	52	24	83	60	59
23. Draw Capillary or Venous Bloods	40	67	26	90	68	67
24. Collect Blood Specimens for Laboratory	42	70	25	86	66	65
25. Stain and Read Alkaline Phosphatase Stain	6	10	7	24	23	23

TABLE 24—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
26. Identify Immature Blood Cells	21	35	19	66	50	50
27. Determine Coagulation Time by Lee-White Method	41	68	24	83	52	51
28. Determine Coagulation Time by Capillary Method	20	33	11	38	23	23
29. Perform Thrombocyte Count	20	33	15	52	41	41
30. Operate Automatic Analyzer for Hematology	19	32	14	48	41	41
31. Operate Automatic Cell Counter	26	43	19	66	52	51
32. Operate Hemoglobinometer	23	38	15	52	41	41
33. Operate Microhematocrit Reader	28	47	23	79	59	58
34. Teach	5	8	1	3	19	19

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

that the percentages of workers performing the tasks were fairly evenly distributed among the three frequencies.

Eighty-seven percent (45 tasks) of the tasks were checked by 50 percent or more of the workers performing the tasks as being taught in school. Only three tasks (6 percent) were checked by 50 percent or more of the workers as being learned on-the-job. Two of these three tasks were "supervise hematology procedures" and "teach." There were four tasks (8 percent) for which the percentages of workers performing the tasks were distributed between school and on-the-job.

Appendix E shows the total number and percentage of workers performing the hematology tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 52 tasks listed under hematology functions. Twenty-seven (52 percent) of the tasks were performed by 50 percent or more of at least one of the three levels of laboratory workers, all 27 of the tasks being performed by 50 percent or more of the technicians. There were 34 tasks (65 percent) for which the percentages of workers performing the tasks differed by more than 10 percent between two or more of the three

categories of workers. For 40 percent of the tasks there was no significant difference between the assistants and the technicians. For 46 percent of the tasks there was no significant difference between the technicians and the technologists. For 83 percent of the tasks there was no significant difference between the assistants and the technologists. Again the smallest number of significant differences in the percentages of workers performing the tasks was between the assistants and the technologists, the opposite of what would normally be expected considering the educational levels of the three categories of workers. The largest number of tasks, 23 (44 percent), were checked by 50 percent or more of the workers performing the tasks as being performed routinely. Forty-five (87 percent) of the tasks were checked by 50 percent or more of the workers performing the tasks as being learned in school.

Urinalysis Functions

There were 29 tasks listed under urinalysis functions. There were nine (31 percent) of these tasks that were performed by 50 percent or more of at least one of the three categories of workers. These are shown in Table 25. Seven of these tasks were performed by 50 percent or more of the assistants, nine by the technicians, and eight by the technologists.

TABLE 25

Urinalysis Tasks Performed by 50 Percent or More of Any One of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Examine Urine Specimens Macroscopically	37	62	23	79	63	62
2. Examine Urine Specimens Microscopically	32	53	22	76	64	63
3. Perform Acetone or Ketone Test	40	67	22	76	56	55
4. Perform Bile Test	37	62	20	69	54	53
5. Perform True Glucose Test	28	47	17	59	50	50
6. Perform pH Test	39	65	19	66	59	58
7. Perform Pregnancy Test	31	52	19	66	55	54
8. Perform Qualitative Urine Protein Test	25	42	18	62	48	48
9. Perform Specific Gravity Test	37	62	20	69	58	57

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

There were 14 tasks (48 percent) for which the percentages of workers performing the tasks differed by more than 10 percent between two or more of the categories of workers. These are shown in Table 26. There were nine tasks (31 percent) for which the differences occurred between the assistants and the technicians with the technicians having the greater percentage in all but two cases. There were four tasks (14 percent) for which the differences occurred between the assistants and the technologists with the assistants having the greater percentage in only one case. There were eight tasks (27 percent) for which the differences occurred between the technicians and the technologists with the technicians having the greater percentage for all but one task.

There were 10 tasks (34 percent) for which 50 percent or more of the workers performing the tasks checked that the tasks were done routinely. No task was checked by 50 percent or more of the workers performing the tasks as being done occasionally. Eight tasks (27 percent) were checked by 50 percent or more of the workers performing the tasks as being done rarely. For the other 11 tasks (38 percent) the percentages were distributed. Four tasks were checked by over 78 percent of the workers performing the tasks as being performed either routinely or occasionally. For one task, 85 percent of the workers

TABLE 26

Urinalysis Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Examine Urine Specimens Macroscopically	37	62	23	79	63	62
2. Examine Urine Specimens Microscopically	32	53	22	76	64	63
3. Perform Acetone or Ketone Test	40	67	22	76	56	55
4. Perform Addis Counts	16	27	4	14	18	18
5. Perform Bile Test	37	62	20	69	54	53
6. Perform Concentration Test	15	25	4	14	18	18
7. Perform True Glucose Test	28	47	17	59	50	50
8. Perform Urine Hemoglobin Test	22	37	13	45	48	48
9. Perform Microscopic Test for Lipids (Fats)	9	15	4	14	26	26
10. Perform Porphyrins Test	22	37	14	48	39	39
11. Perform Pregnancy Test	31	52	19	66	55	54
12. Perform Qualitative Urine Protein Test	25	42	18	62	48	48

TABLE 26—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
13. Perform Urine Reducing Substance	12	20	10	34	38	38
14. Perform Specific Gravity Test	37	62	20	69	58	57

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

performing the task were distributed between occasionally and rarely. For the other six tasks the percentages of workers performing the tasks were fairly evenly distributed between the three frequencies.

Twenty-five of the tasks (86 percent) were checked by 50 percent or more of the workers as being learned in school. Three tasks (10 percent) were checked by 50 percent or more of the workers as being learned on-the-job. For one task the percentage of workers performing the task was evenly divided between in school and on-the-job as the place the task was taught. "Teach" and "supervise urinalysis procedures" were two of the tasks indicated by 50 percent or more of the workers performing the tasks as learned on-the-job.

Appendix F shows the total number and percentages of workers performing the hematology tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentage of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 29 tasks listed under urinalysis functions. Of these nine tasks (31 percent) were performed by 50 percent or more of at least one of the three categories of laboratory workers. There were 14 tasks (48 percent) for which there was a significant difference of over 10 percent between the percentages of two or

more of the three levels of workers performing the tasks. For 20 of the tasks (69 percent) there was no significant difference between the percentages of assistants and the percentages of technicians performing the tasks. For 86 percent of the tasks there was no significant difference between the assistants and the technologists. For 73 percent of the tasks there was no significant difference between the technicians and the technologists. Again the smallest number of times for which there was a significant difference between two groups of workers occurred between the assistants and the technologists. Fifty percent or more of the workers checked routinely as the frequency of the performance of a task more often (34 percent) than either of the other two frequencies. School was indicated for 86 percent of the tasks as the place where 50 percent or more of the workers performing the duty learned to do the tasks.

Serology and Virology Functions

There were a total of 31 tasks listed under serology and virology functions. Only two tasks (6 percent) were performed by 50 percent or more of at least one of the three levels of workers. These two tasks, "perform slide agglutination test for mononucleosis" and "perform VDRL," were both performed by 52 percent of the technicians. There

was no task performed by 50 percent or more of the assistants or the technologists.

There were four tasks (13 percent) for which there was a difference of more than 10 percent between the percentages of the three categories of workers performing the tasks. These are shown on Table 27. There were three tasks (10 percent) for which there was a significant difference between the assistants and the technicians with the assistants having the higher percentage for two of the tasks. There was only one task (3 percent) for which there was a difference of over 10 percent between the percentages of assistants and technologists performing the tasks, the assistants having the higher percentages. There were two tasks (6 percent) for which there was a significant difference between the technicians and the technologists, the technicians having the greater percentage for one task and the technologists the greater for the other task.

For frequency of performance of the tasks, 50 percent or more of the workers performing the tasks checked rarely more often than any of the other two frequencies, 10 tasks (32 percent). There were two tasks (6 percent) for which 50 percent or more of the workers performing the tasks checked routinely and one task (3 percent) for which they checked occasionally. The other 17 tasks (55 percent) did not have any one frequency checked by 50 percent or

TABLE 27

Serology and Virology Tasks Differing by More Than 10 Percent Among the Percentage of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Perform Antistreptolysin "O" Titers	24	40	7	24	36	36
2. Perform "C" Reactive Protein Test	26	43	9	31	36	36
3. Perform Latex Fixation Test	27	45	12	41	34	34
4. Perform VDRL	22	37	15	52	31	31

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

more of the workers. There were two tasks for which 75 percent or more of the workers performing the tasks checked either routinely or occasionally and one task in which 77 percent of the workers performing the task checked either occasionally or rarely. For the other tasks, the percentages of workers performing the tasks were divided among the three frequencies.

There were 27 tasks (87 percent) for which 50 percent or more of the workers performing the tasks indicated in school as the place the tasks were learned. There was one task (3 percent), "do research," for which the only two workers checking that task indicated on-the-job as the place the task was taught. Two tasks had the percentages of workers performing the tasks split between in school and on-the-job.

Appendix G shows the total number and percentage of workers performing the serology and virology tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 31 tasks listed under serology and virology functions. There were two tasks (6 percent) performed by 50 percent or more of the technicians, and none by 50 percent or more of the technologists and assistants. For 13 percent of the tasks there was a difference of more

than 10 percent among the three levels of laboratory workers performing the tasks. For 90 percent of the tasks there was no significant difference between the assistants and the technicians performing the tasks. For 97 percent there was no significant difference between the assistants and the technologists, and for 94 percent there was no significant difference between the technicians and the technologists. For the largest number of tasks, 17 (55 percent), no one frequency of performance was checked by 50 percent or more of the workers performing the tasks. For 32 percent of the tasks, 50 percent or more of the workers performing the tasks checked rarely as the frequency of performance. Two tasks were checked as being performed routinely and one task as performed occasionally by 50 percent or more of the workers performing the tasks. All but three tasks (87 percent) were checked by 50 percent or more of the workers performing the tasks as being learned in school. One task was checked by 50 percent or more of the workers performing the task as being taught on-the-job and the other two tasks had the percentages of workers performing the tasks split between in school and on-the-job.

Parasitology Functions

There were 13 tasks listed under parasitology functions. None of these tasks was performed by 50 percent or more of any of the three categories of laboratory workers.

There were four tasks (31 percent) for which there was a difference of more than 10 percent between two or more of the three levels of workers. These are shown on Table 28. For two of the tasks (15 percent), the difference of over 10 percent was between the assistants and the technicians, with the technicians having the higher percentage for one task and the assistants the higher for the other. For one task (8 percent) the significant difference was between the assistants and the technologists with the technologists having the higher percentage. There were three tasks (23 percent) for which the technicians and the technologists differed by more than 10 percent in the percentages of workers performing the tasks. For all three tasks the technologists had the larger percentage of workers performing the tasks.

There was one task (8 percent) that was checked by 50 percent or more of the workers performing the task as being done routinely, and one task checked by 50 percent or more as being done occasionally. Four tasks (31 percent) were checked by 50 percent or more of the workers performing the tasks as being done rarely. The remaining seven tasks (54 percent) had no one frequency checked by 50 percent or more of the workers performing the tasks. Three of these tasks were checked by over 75 percent of the workers performing the tasks as being done either routinely or occasionally and one task had 75 percent of the workers

TABLE 28

Parasitology Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Examine Specimens Macroscopically	18	30	6	21	40	40
2. Perform Concentration and Flotation Techniques	24	40	6	21	37	37
3. Stain Parasitological Smears	6	10	6	21	22	22
4. Supervise Parasitology Procedures	4	7	1	3	14	14

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

performing the task divided between occasionally and rarely. The other three tasks had the percentages of workers performing the tasks fairly evenly distributed among the three frequencies.

For all but one task (92 percent), in school was indicated by 50 percent or more of the workers performing the tasks as the place the tasks were learned. For the other task, "supervise parasitology procedures," the percentage of workers performing the task was evenly divided between in school and on-the-job as the place the task was taught.

Appendix H shows the total number and percentages of workers performing the parasitology tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 13 tasks listed under parasitology functions. None was performed by 50 percent or more of any of the three categories of laboratory workers. Four tasks (31 percent) differed by more than 10 percent between the percentages of two or more of the three levels of workers performing the tasks. For 85 percent of the tasks there was no significant differences between the percentages of assistants and technicians performing the

tasks. For 92 percent of the tasks, there was no significant difference between the assistants and the technologists. For 77 percent of the tasks there was no significant difference between the percentages of technicians and technologists performing the tasks. For the largest number of tasks, seven (54 percent), none of the three frequencies of performance was checked by 50 percent or more of the workers performing the tasks. For 31 percent of the tasks, rarely was checked by 50 percent or more of the workers performing the tasks. Routinely and occasionally were checked for one task each by 50 percent or more of the workers performing the tasks. For all but one task (92 percent), in school was checked by 50 percent of the workers performing the tasks as the place the tasks were taught.

Mycology Functions

There were 10 tasks listed under mycology duties. None of these tasks was performed by 50 percent or more of any of the three educational levels of laboratory workers. There were three tasks (30 percent) for which there was a difference of more than 10 percent between the percentages of two or more of the three levels of workers performing the tasks. These are shown on Table 29. There were two tasks (20 percent) for which the difference was between the assistants and the technicians, the assistants having the higher percentage for one task, and the technicians, the higher for

TABLE 29

Mycology Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Cultivate Mycology Specimens for Primary Isolation	7	12	6	21	25	25
2. Perform KOH Preparation for Dermatophytes	6	10	6	21	17	17
3. Prepare Culture Media	11	18	2	7	17	17

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

the other task. There was one task (10 percent) for which there was a difference of over 10 percent between the percentages of assistants and technologists performing the tasks. The technologists had the greater percentage for this task. There were no tasks for which there was a significant difference of more than 10 percent between the percentages of technicians and technologists performing the tasks.

There was one task (10 percent), "teaching," for which 50 percent or more of the workers performing the task indicated the task was done routinely. No task was checked by 50 percent or more of the workers performing the task as being done occasionally. Sixty percent (six tasks) were checked by 50 percent or more of the workers performing the tasks as being done rarely. For the other three tasks (30 percent), the distribution of the percentages of workers performing the tasks was divided among the three frequencies with no one frequency being checked by 50 percent or more of the workers performing the tasks.

There were nine tasks (90 percent) for which in school was indicated by 50 percent or more of the workers performing the tasks as the place the tasks were taught. One task (10 percent), "do research," was performed by only one worker in the survey, and he indicated on-the-job as the place where he was taught to perform the task.

Appendix I shows the total number and percentage of workers performing the mycology tasks, the percentages of these workers who performed the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 10 tasks listed under mycology functions. None was performed by 50 percent or more of any of the three levels of laboratory workers. There were three tasks (30 percent) that differed by more than 10 percent between the percentages of two or more of the three levels of laboratory workers performing the task. For 80 percent of the tasks there was no significant difference in the percentages of assistants and technicians performing the tasks. For 90 percent of the tasks there was no significant difference between the percentages of assistants and technologists performing the tasks. For 100 percent of the tasks there was no significant difference in the percentages of technicians and technologists performing the tasks. Sixty percent of the tasks were checked by 50 percent or more of the workers performing the tasks as being performed rarely. One task was checked by 50 percent or more of the workers performing the task as being performed routinely. The percentages of workers performing the tasks for the other three tasks were distributed among the three

frequencies with no one frequency being checked by 50 percent or more of the workers performing the tasks. All but one task (90 percent) were checked by 50 percent or more of the workers as being learned in school. The other task was indicated as being taught on-the-job.

Nuclear Laboratory Medicine Functions

There were 14 tasks listed under nuclear laboratory medicine duties. None of these tasks was performed by 50 percent or more of any of the three categories of laboratory workers. There were five tasks (36 percent) for which there was a difference of more than 10 percent between the percentages of two or more of the three levels of laboratory workers performing the tasks. There are shown in Table 30. There were four tasks (29 percent) for which there was a difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. The technicians had the higher percentage for all four tasks. There was one task (7 percent) for which there was a difference of more than 10 percent between the percentages of assistants and technologists performing the task, the technologists having the higher percentage. There were three tasks (21 percent) for which there was a difference of more than 10 percent between the percentages of technicians and technologists performing the tasks. The technicians had the higher percentage for all three tasks.

TABLE 30

Nuclear Laboratory Medicine Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Assist in Preparation and Counting of Samples	10	17	8	28	9	9
2. Conduct Test for Presence and Measurement of Radioactivity	5	8	6	21	8	8
3. Count Body Fluid Specimens	5	8	6	21	8	8
4. Maintain Safety Standards	4	7	4	14	6	21
5. Use Radioisotope Measurement Instruments	3	5	5	17	7	7

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

There were eight tasks (57 percent) that were checked by 50 percent or more of the workers performing the tasks as being done routinely. One task (7 percent) was checked by 50 percent or more of the workers as being done occasionally and one task as being done rarely. There were three tasks (21 percent) for which no one frequency was checked by 50 percent or more of the workers who performed the tasks. For one task, 79 percent of the workers who performed the task checked either routinely or occasionally. For the other two tasks the distribution of the percentages were divided among the three frequencies.

There were 12 tasks (86 percent) for which 50 percent or more of the workers performing the tasks indicated that they learned the duty on-the-job. There was only one task, "perform autoradiography," that was indicated by the one worker in the survey who performed the task as being taught in school. For one task the percentages of workers performing the task was evenly divided between in school and on-the-job.

Appendix J shows the total number and percentages of workers performing the nuclear laboratory medicine tasks, the percentages of these workers who performed the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 14 tasks listed under nuclear laboratory medicine duties. None of these was performed by 50 percent of any of the three educational levels of laboratory workers. Thirty-six percent of the tasks differed by more than 10 percent between the percentages of two or more of the three levels of laboratory workers performing the tasks. For 71 percent of the tasks, there was no significant difference between the percentages of assistants and technicians performing the tasks. For 93 percent of the tasks, there was no significant difference between the percentages of assistants and technologists performing the tasks. For 79 percent of the tasks there was no significant difference between the percentages of technicians and technologists performing the tasks. The largest number of tasks, eight (57 percent), was indicated by 50 percent or more of the workers performing the tasks as being done routinely. Fifty percent of the workers performing the tasks checked occasionally for the frequency of performance for only one task (7 percent) and rarely for only one task. For the other three tasks (21 percent) the distribution of the percentages of workers performing the tasks was divided among the three frequencies. There was only one task for which 50 percent or more of the workers indicated in school as the place the task was taught. For one task the percentages of workers performing the task was

evenly divided between in school and on-the-job as the place the task was taught. For all the other tasks, on-the-job was indicated by the majority of workers performing that task as the place the task was taught.

Bacteriology Functions

There were 31 tasks listed under bacteriology functions. There were three tasks (10 percent) that were performed by 50 percent or more of at least one of the three categories of workers. The tasks are shown on Table 31. The three tasks were performed by 50 percent or more of the technicians only. None of the 31 tasks was performed by 50 percent or more of the assistants or technologists.

There were 16 tasks (52 percent) for which there was a difference of more than 10 percent between the percentages of two or more of the three categories of workers performing the tasks. These tasks are shown in Table 32. There were 12 tasks (39 percent) for which there was a difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. For all 12 tasks the technicians had the greater percentages. There were 10 tasks (32 percent) for which there was a significant difference between the percentages of assistants and technologists. For all 10 tasks the technologists had

TABLE 31

Bacteriology Tasks Performed by 50 Percent or More of Any One of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Make Smears for Microscopic Examinations	29	48	18	62	46	46
2. Perform Initial Planting of Cultures	21	35	15	52	42	42
3. Streak Plates	27	45	17	59	46	46

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

TABLE 32

Bacteriology Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Clean Area and Equipment Aseptically	11	18	10	34	30	30
2. Examine Specimens Microscopically	12	20	9	31	38	38
3. Identify and Classify Bacteria	11	18	9	31	34	34
4. Identify Bacteria Morphologically	9	15	9	31	36	36
5. Inoculate Media for Biochemical Tests	14	23	11	38	34	34
6. Maintain Stock Cultures	10	17	3	10	25	25
7. Make Smears for Microscopic Examination	29	48	18	62	46	46
8. Perform Initial Planting of Cultures	21	35	15	52	42	42
9. Perform Special Staining	11	18	6	21	29	29
10. Perform Serological Identification of Bacteria	9	15	6	21	26	26
11. Read Antibiotic Sensitivity Tests	8	13	8	28	28	28
12. Read Results of Biochemical Tests	7	12	9	31	30	30

TABLE 32—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
13. Stain Smears for Microscopic Examination	21	35	14	48	45	45
14. Streak Plates	27	45	17	59	46	46
15. Teach	2	3	-	-	15	15
16. Use Anaerobic Devices	11	18	11	38	27	27

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

the greater percentage. There were five tasks (16 percent) for which there was a difference of more than 10 percent between the percentages of technicians and technologists performing the tasks. For three tasks the technicians had the greater percentage. For the other two tasks the technologist had the greater percentage.

There were 13 tasks (42 percent) for which 50 percent or more of the workers doing the tasks indicated that the tasks were performed routinely. For six tasks (19 percent), 50 percent or more of the workers performing the tasks indicated rarely as the frequency of performance. There was one task (3 percent) for which 50 percent or more of the workers performing the task indicated occasionally as the frequency of performance. For 11 tasks (35 percent) the distribution of the percentages of workers performing the tasks was divided among the three frequencies. For six of these tasks the percentages were divided so that over 75 percent of the workers indicated either routinely or occasionally as the frequency of performance. For three tasks, occasionally or rarely was checked by over 85 percent of the workers as the frequency of performance.

There were 27 tasks (87 percent) for which 50 percent or more of the workers performing the tasks checked in school as the place the tasks were learned. For two tasks (6 percent) on-the-job was indicated by 50 percent or

more of those workers performing the tasks. There were two tasks for which the percentages of workers performing the tasks were split between in school and on-the-job so that neither was checked by 50 percent or more of the workers.

Appendix K shows the total number and percentages of workers performing the bacteriology tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there were 31 tasks listed under bacteriology functions. Three of these tasks (10 percent) were performed by 50 percent or more of the technicians. None was performed by 50 percent or more of the assistants or technologists. There were 16 tasks (52 percent) for which there was a difference of more than 10 percent between the percentages of two or more of the laboratory workers performing the tasks. For 61 percent of the tasks there was no significant difference between the assistants and the technicians performing the tasks. For 68 percent of the tasks there was no significant difference between the percentages of assistants and technologists. For 84 percent of the tasks there was no significant difference between the percentages of technicians and technologists

performing the tasks. The largest number of tasks, 13 (42 percent), was checked by 50 percent or more of the workers performing the tasks as being done routinely. For the next largest number, 11 (35 percent), the percentages were split so that no one frequency was checked by 50 percent or more of the workers. For all but four tasks (87 percent), in school was designated by 50 percent or more of workers performing the tasks as the place the tasks were learned. Two tasks (6 percent) were checked by 50 percent or more of the workers performing the tasks as being learned on-the-job. For the other two tasks, the percentages of workers performing the tasks were split between on-the-job and in school.

Blood Bank Functions

There were 41 tasks listed under blood bank duties. Only one of these, "draw patient's blood for grouping, typing, and cross-match," was checked by 50 percent or more of any of the three categories of workers. The percentages of each of the groups checking this task were as follows: assistants—53 percent, technicians—62 percent, technologists—43 percent.

For 15 tasks (37 percent) there was a difference of more than 10 percent between the percentages of two or more of the three categories of workers performing the tasks. These are shown in Table 33. There were seven tasks (17

TABLE 33

Blood Bank Tasks Differing by More Than 10 Percent Among the Percentages of the Three Levels of Laboratory Workers

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
1. Attach Serial Numbers to Units	4	7	5	17	5	5
2. Centrifuge and Separate Serum from Clot	12	20	11	38	21	21
3. Check and Record Temperature of Refrigerators and/or Alarms	11	18	8	28	17	17
4. Dispose of Unused Blood After Expiration Time Limit	7	12	6	21	10	10
5. Draw Patient's Blood for Grouping, Typing and Cross-match	32	53	18	62	43	43
6. Maintain Blood Inventory	11	18	8	28	12	12
7. Perform Absorption Technique	4	7	7	24	10	10
8. Perform Antibody Titers (Dilutions)	7	12	7	24	12	12
9. Perform Elution Technique	3	5	6	21	10	10
10. Perform First Aid for Shock	5	8	5	17	3	3
11. Perform Genotype of Blood	6	10	7	24	13	13
12. Prepare and Read Tube Agglutination Reactions	9	15	9	31	20	20

TABLE 33—*Continued*

Tasks	Assistant		Technician		Technologist	
	Number	Percent*	Number	Percent*	Number	Percent*
13. Prepare Contols	4	7	5	17	4	4
14. Prepare Special Blood Fractions	3	5	4	14	3	3
15. Process Blood for Packed Cells	6	10	7	24	12	12

*Percentages represent distribution within each division of laboratory worker, and are based on the total number of respondents within each division: Assistants = 60, Technicians = 29, Technologists = 101, Total = 190.

percent) for which the difference was between the assistants and the technicians. For all seven tasks the technicians had the higher percentages. For all 15 tasks (37 percent) there was a significant difference between the percentages of the technicians and technologists performing the tasks. For all 15 tasks the technicians had the greater percentages. There was no task for which there was a difference of more than 10 percent between the percentages of assistants and technologists performing the task.

For the largest number of tasks, 18 (43 percent), the percentages of workers performing the tasks were divided among the three frequencies of performance so that no one frequency was checked by 50 percent or more of the workers. There were six tasks of the 18 for which 75 percent or more of the workers checked either routinely or occasionally, and two for which either occasionally or rarely were checked. For the other 10 of the 18 tasks, the percentages of workers performing the tasks were fairly evenly distributed among the three frequencies. There were 13 tasks (31 percent) for which 50 percent or more of the workers performing the tasks checked routinely as the frequency of performance. One task (2 percent) was checked by the majority of the workers as being done occasionally. Nine tasks (22 percent) were checked by 50 percent or more of the workers performing the tasks as being done rarely.

There were 30 tasks (73 percent) for which 50 percent or more of the workers indicated in school as the place the tasks were learned. For nine tasks (22 percent), on-the-job was indicated as the place the majority of the workers performing the duty learned the tasks. For one task (2 percent) the percentage of workers performing the task was split between on-the-job and in school.

Appendix L shows the total number and percentage of workers performing the blood bank tasks, the percentages of these workers who perform the tasks routinely, occasionally, and rarely, and the percentages of these workers who learned to perform the tasks in school, on-the-job, and in continuing education programs.

In summary, there was a total of 41 tasks listed under blood bank functions. Only one task was performed by 50 percent or more of any of the three categories of laboratory workers. There were 15 tasks (37 percent) for which there was a difference of more than 10 percent between the percentages of two or more of the three levels of workers performing the tasks. For 83 percent of the tasks there was no significant difference between the assistants and the technicians. For 100 percent of the tasks there was no significant difference between the assistants and the technologists. For 63 percent of the tasks there was no difference of more than 10 percent between the percentages

of technicians and technologists performing the tasks. For the largest number of tasks, 18 (43 percent), the percentages of workers performing the tasks were divided among the three frequencies of performance. For 13 tasks (31 percent) routinely was checked as the frequency of performance and for nine tasks (22 percent) rarely was checked as the frequency of performance by 50 percent or more of the workers performing the task. Thirty tasks (73 percent) were checked by 50 percent or more of the workers performing the tasks as being learned in school. Nine (22 percent) were checked as being learned on-the-job, and one task had the percentages of workers performing the task divided between in school and on-the-job.

Summary

The purpose of this chapter was to present the data pertaining to the actual performance of tasks which were obtained from 190 laboratory workers responding to Part II and Part III of the Duval County Task Analysis Survey. Each clinical area, as well as managerial, teaching, and miscellaneous areas, was examined with reference to the number and percentages of assistants, technicians, and technologists performing the tasks listed under the individual area, the frequency of performance of the tasks, and where the tasks were learned. Comments were made regarding the differences

between the percentages of each of the three categories of laboratory workers performing the tasks.

CHAPTER V

SUMMARY, FINDINGS, AND CONCLUSIONS

The purpose of this chapter is to summarize the findings from the study of a task analysis of medical laboratory workers in hospitals in Duval County, Florida. Conclusions are presented concerning standards established by the World Health Organization (24). Recommendations are made for curriculum development, laboratory licensing, laboratory restructuring, and for further research.

Summary

The purpose of this study was to survey and analyze the types of tasks performed by three educational categories of medical laboratory technical personnel. Determining the educational background needed to perform various laboratory tasks would make it possible to make recommendations for future curriculum and course development for the training and retraining of laboratory workers.

The problem was stated in the form of six questions. Question one asked what were the demographic, educational, and employment characteristics of the various levels of medical laboratory technical personnel in hospitals in Duval

County, Florida. Question two asked what laboratory tasks these various workers performed. Question three was concerned with how frequently the workers performed these tasks and question four with where they learned to perform these tasks. Considering the information derived from the other questions, question five of the problem was concerned with determining what implications could be drawn for future curriculum development for the training or retraining of laboratory workers. The last question asked for a conclusion as to the need for three distinct educational levels of medical laboratory workers.

The procedure was to deliver a questionnaire to all clinical laboratory workers in hospitals in Duval County. The questionnaire included data on the general background characteristics of the workers and on the tasks they performed in the laboratory. Data were coded and punched on Indecks® cards and information retrived by a manual keysort system.

Findings

The information that formed the bases for this study was derived from responses to a questionnaire completed by 190 clinical laboratory workers from 10 hospitals in Duval County, Florida.

Briefly, the findings of the survey are as listed by sections below:

Demographic Characteristics

1. From the findings of the Duval County Task Analysis Survey, it was concluded that clinical laboratory workers in hospitals in Duval County are predominately married females under 30 years of age with a salary range of $7,200 to $11,999.

2. Very little difference was found among the three educational levels of laboratory workers surveyed concerning sex, age, and marital status.

3. Based upon survey findings, a greater percentage of assistants are in the lower income bracket than are the other two levels of laboratory workers. The greatest percentage of the technologists are in the upper income bracket while the greatest percentage of technicians are in the middle income bracket. The salaries parallel training requirements.

Training Characteristics

1. Formal educational achievement was one of the criteria for separation of the laboratory workers surveyed into categories. As a result, all of the assistants had less than two years of college, all of the technicians had from two to four years of college, and all of the technologists had completed three or more years of college.

2. The majority of the technologists surveyed had majored in medical technology for their bachelor's degree.

3. For those laboratory workers surveyed, on-the-job training was the primary source of training reported for assistants. Both on-the-job training and training in junior college or vocational-technical centers were equally common among technicians. Technologists primarily received their training in ASCP approved schools.

4. Of those laboratory workers surveyed, 76 percent of the assistants held no certification or registration. The majority of technicians either held no certification or registration or were certified as Medical Laboratory Technicians (ASCP). Eighty percent of the technologists were ASCP certified Medical Technologists.

Employment Characteristics

1. The laboratory workers surveyed had been employed in the hospitals in which they were presently working for less than four years with the technicians having been employed about one and one-half years less than either the assistants or the technologists.

2. The laboratory workers surveyed had been employed in the medical laboratory profession a little over seven years, with the technicians having been employed about three years less than the assistants or the technologists.

3. All three levels of laboratory workers surveyed were employed predominately full time.

4. The largest percentage of assistants were licensed as Laboratory Technicians, the largest percentage of technicians were licensed as Laboratory Technicians, and the largest percentage of technologists were licensed as Medical Technologists.

5. Although, according to Florida licensing requirements, none of the assistants surveyed should hold licenses as Technologists or Supervisors, 22 percent of them did hold one or the other of these licenses.

6. According to Florida licensing requirements, all but two of the surveyed laboratory workers should be licensed, however 16 percent are not.

7. Biochemistry and hematology were the two areas of major responsibility most frequently indicated by all three of the educational levels of laboratory workers surveyed.

8. The largest percentage of both assistants and technicians surveyed indicated their position as laboratory technicians. The largest percentage of technologists surveyed indicated their position as medical technologists.

9. All of the laboratory workers surveyed indicated that they had a pathologist who was available for consultation, and 89 percent replied that the pathologist was in the laboratory at all times or was available when needed.

10. Eighty-six percent of all the laboratory workers surveyed indicated that they worked under the supervision of another laboratory worker, and 62 percent of these workers stated that they worked under the supervision of a section supervisor or chief technologist.

11. Although, according to Florida licensing and ASCP certification requirements, assistants and technicians should at all times work under the supervision of a technologist or physician, 10 percent of the assistants and 17 percent of the technicians responded that they do not work under the supervision of another laboratory worker.

12. Over 90 percent of all the workers surveyed felt they had the responsibility to use independent judgment in the performance of their duty.

13. Although, according to the Florida Licensing Law and ASCP certification, the ability to exercise independent judgment in the performance of duties is restricted for both assistants and technicians, only three percent of these two groups felt that they were restricted.

Tasks Performed

1. For the ten tasks performed by the most technologists, six of these tasks were in the top 10 tasks performed by both assistants and technicians and eight were in the top 20 of the tasks performed by assistants and technicians.

Managerial Tasks

1. There were 52 tasks listed under managerial duties in the questionnaire. None was performed by 50 percent or more of the three levels of laboratory workers surveyed.

2. For eight tasks performed (15 percent), there was a significant difference of more than 10 percent between the percentages of assistants and the percentages of technicians performing the tasks. For 12 tasks (23 percent) there was a significant difference between the percentages of assistants

and technologists. For 10 tasks (19 percent) there was a significant difference between the percentages of technologists and technicians performing the tasks.

3. The largest percentage of the tasks (69 percent) was indicated by 50 percent or more of the laboratory workers performing the tasks as being performed routinely.

4. All but one task was checked by 50 percent or more of the workers performing the tasks as being learned on-the-job.

Teaching Tasks

1. Eighteen tasks were listed under teaching duties in the questionnaire. One task was checked by 50 percent or more of the technologists as a duty they perform.

2. There were two tasks (11 percent) performed by a significantly greater percentage of technicians than assistants, four tasks (22 percent) performed by a significantly greater percentage of technologists than assistants, and three tasks (17 percent) that were performed by a significantly greater percentage of technologists than technicians.

3. The greatest percentage of the tasks (50 percent) were checked by 50 percent or more of the workers performing the tasks as being done occasionally.

4. All the tasks were checked by 50 percent or more of the workers performing the tasks as being learned on-the-job.

Miscellaneous Tasks

1. Fifty tasks were listed under miscellaneous duties. Twenty-four (48 percent) of these tasks were performed by 50 percent or more of at least one of the three educational levels of laboratory workers.

2. Twenty-five tasks (50 percent) were performed by a significantly greater percentage of technicians than assistants. For 22 tasks (44 percent) there

was a significant difference of more than 10 percent between the assistants and the technologists performing the tasks. For nine tasks (18 percent) there was a significant difference in the percentages of technicians and technologists performing the tasks.

3. Over 50 percent of the tasks were checked by 50 percent or more of the workers performing the tasks as being performed routinely.

4. On-the-job was indicated for the majority of the tasks (64 percent) by 50 percent or more of the workers performing the tasks as the place the tasks were learned.

Biochemistry Tasks

1. Eighty-five tasks were listed under biochemistry duties in the questionnaire. Thirty tasks (35 percent) were checked by 50 percent or more of at least one of the three categories of laboratory workers.

2. For 38 of the tasks (45 percent) there was a significant difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. For four tasks (5 percent) there was a significant difference between the percentages of assistants and technologists. For 25 tasks (29 percent) there was a significant difference between the percentages of technicians and technologists performing the tasks.

3. For the largest percentage of tasks (35 percent), routinely was checked by 50 percent or more of the workers performing the tasks as the frequency of performance.

4. For the majority of the tasks (66 percent), in school was checked by 50 percent or more of the workers performing the tasks as the place the tasks were learned.

Hematology Tasks

1. Fifty-two tasks were listed under hematology duties in the questionnaire. Of these, 52 percent were

were checked by 50 percent or more of at least one of the three categories of workers.

2. For 31 tasks (60 percent), there was a significantly greater percentage of technicians than assistants who performed the tasks. For nine tasks (17 percent) there was a significant difference of more than 10 percent between the percentages of assistants and technologist performing the tasks. For 28 tasks (54 percent) there was a significant difference between the percentages of technicians and technologists with the technicians having the greater percentage for all but one task, which was teaching.

3. The greatest percentage of tasks (44 percent) were checked by 50 percent or more of the workers performing the tasks as being performed routinely.

4. Over 80 percent of the tasks were checked by 50 percent or more of the workers performing the tasks as being taught in school.

Urinalysis Tasks

1. Twenty-nine tasks were listed under urinalysis functions. Nine of these tasks (31 percent) were performed by 50 percent or more of at least one of the three categories of workers.

2. For nine tasks (31 percent) there was a significant difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. There were four tasks (14 percent) for which there was a significant difference between the percentages of technologists and technicians performing the tasks.

3. The largest percentage of tasks (34 percent) were checked by 50 percent or more of the workers performing the tasks as being done routinely.

4. Over 80 percent of the tasks were checked by 50 percent or more of the workers as being learned in school.

Serology and Virology Tasks

1. Thirty-one tasks were listed under serology and virology tasks. There were two tasks performed by 50 percent or more of the technicians.

2. There were three tasks (10 percent) for which there was a significant difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. For one task (3 percent) there was a significant difference between the percentages of assistants and technologists performing the tasks. For two tasks (6 percent) there was a significant difference between the percentages of technicians and technologists performing the tasks.

3. For frequency of performance of the tasks, 50 percent or more of the workers performing the tasks checked rarely more often than any of the other two frequencies, 10 tasks (32 percent).

4. For over 80 percent of the tasks, 50 percent or more of the workers performing the tasks indicated school as the place the tasks were learned.

Parasitology Tasks

1. Thirteen tasks were listed under parasitology duties in the questionnaire. None of these tasks was performed by 50 percent or more of any of the three levels of laboratory workers.

2. There were two tasks (15 percent) for which there was a difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. For one task (8 percent) there was a significant difference between the percentages of assistants and technologists. For three tasks (23 percent) there was a difference of more than 10 percent between the percentages of technicians and technologists performing the tasks.

3. For frequency of performance of the tasks, 50 percent or more of the workers performing the tasks checked rarely more often than either of the other two frequencies, four tasks (31 percent).

4. For over 90 percent of the tasks, in school was indicated by 50 percent or more of the workers performing the tasks as the place the tasks were learned.

Mycology Tasks

1. Ten tasks were listed under mycology duties in the questionnaire. None of these tasks was performed by 50 percent or more of any of the three educational levels of laboratory workers.

2. For two tasks (20 percent) there was a difference of more than 10 percent between the percentages of assistants and technicians performing the tasks. There was one task (10 percent) for which there was a significant difference between the percentages of assistants and technologists. For no task was there a difference of more than 10 percent between the percentages of technicians and technologists performing the tasks.

3. Sixty percent of the tasks were checked by 50 percent or more of the workers performing the tasks as being done rarely.

4. For 90 percent of the tasks, 50 percent or more of the workers checked in school as the place the tasks were learned.

Nuclear Laboratory Medicine Tasks

1. Fourteen tasks were listed under nuclear laboratory medicine duties in the questionnaire. None of these was performed by 50 percent or more of any of the three educational levels of laboratory workers.

2. For four tasks (29 percent) there was a significantly greater percentage of technicians than assistants performing the tasks. There was one task (7 percent) for which there was a significantly greater percentage of technologists than assistants performing the tasks. There were three tasks (21 percent) for which there were a significantly greater percentage of technicians than technologists performing the tasks.

3. Over 50 percent of the tasks was checked by 50 percent or more of the workers performing the tasks as being done routinely.

4. For over 80 percent of the tasks, on-the-job was checked by 50 percent or more of the workers performing the tasks as the place the tasks were learned.

Bacteriology Tasks

1. Thirty-one tasks were listed under bacteriology duties. Three of these tasks (10 percent) were performed by 50 percent or more of the technicians.

2. For 12 tasks (39 percent) there was a significantly greater percentage of technicians than assistants performing the tasks. For 10 tasks (32 percent) there was a significantly greater percentage of technologists than assistants performing the tasks. There were five tasks (16 percent) for which there was a significant difference in the percentages of technicians and technologists performing the tasks.

3. The largest percentage of tasks (42 percent) were checked by 50 percent or more of the workers performing the tasks as being performed routinely.

4. For over 80 percent of the tasks, 50 percent or more of the workers performing the tasks indicated in school as the place the tasks were learned.

Blood Bank Tasks

1. Forty-one tasks were listed under blood bank duties in the questionnaire. There was one task which was performed by over 50 percent of the assistants and the technicians. There were seven tasks (17 percent) for which a significantly greater percentage of technicians than assistants performed the tasks. For 15 tasks (37 percent) there was a significantly greater percentage of technicians than technologists who performed the tasks. There were no tasks for which there was a difference of more than 10 percent between the percentages of assistants and technologists performing the tasks.

3. For frequency of performance of the tasks, 50 percent or more of the workers performing the tasks checked routinely more often than either of the other two frequencies, 13 tasks (31 percent).

4. Over 70 percent of the tasks were checked by 50 percent or more of the workers performing the tasks as being learned in school.

Conclusions

The primary purpose of this study was to determine what tasks in the clinical laboratory are performed by each of three educational categories of technical laboratory workers who work in hospital laboratories. Sufficient data were obtained to conclude that this purpose was fulfilled.

Guidelines for the type of laboratory duties each of the three educational levels of laboratory workers should perform are outlined in various references (2, 4, 12, 17, 18). The World Health Organization (24), in the author's opinion, however, gives the most detailed and clearest presentation, and, therefore, the conclusions reached in this study are made in comparison with the functions and duties recommended by the World Health Organization.

The basic functions recommended by the World Health Organization for the graduate technician, corresponding to the technologists in this study, are supervision and teaching of other technical personnel, administrative duties as assigned by the director of the laboratory, and the performance of specialized tests.

The basic functions recommended by the World Health Organization for nongraduate certified technicians, corresponding to the technicians in this study, include performance of all routine and some special laboratory procedures, assisting in the teaching and supervision of subordinate technical personnel, the preparation of specimens and reagents, and the maintenance of equipment.

The basic functions recommended by the World Health Organization for the certified and noncertified assistant technicians, corresponding to the assistants in this study, include repetition of well-established or the simpler routine laboratory procedures, operation of instruments, and recording and reporting of results.

Ideally, according to the World Health Organization standards, there would be a hierarchial arrangement of functions in the clinical laboratory with a small overlap in duties between adjacent levels of workers. This was not found to be the arrangement in the clinical laboratories surveyed in this study. For 233 of the 426 tasks (55 percent) there was no significant difference among the percentages of the three educational levels of laboratory workers performing the tasks. In other words, regardless of the educational background of the worker, the same percentage of workers in each category performed the same tasks. When each category of worker was compared

with the other two categories, it was found that the assistants and the technologists, the two categories furthest apart in educational achievement, performed more of the same tasks than any of the other two combinations of workers. There were only 69 tasks (16 percent) for which there was a significant difference of over 10 percent between the percentages of the assistants and technologists performing the tasks. There were 111 tasks (26 percent) for which there was a significant difference between the percentages of technicians and technologists, and 143 tasks (34 percent) for which there was a significant difference in the percentages of assistants and technicians performing the tasks.

Over 60 percent of the managerial and teaching tasks were performed by essentially the same percentages of each of the categories of workers. When there was a significant difference between two categories (with the exception of three tasks) the category of laboratory worker with the highest educational achievement had the greater percentage of workers performing the task.

The only comprehensive statement that can be made concerning the nine clinical areas is that essentially the same percentage of assistants and technologists appear to be performing the same tasks more often than either of the other two combinations of workers. When a significant

difference did occur between the percentages of two of the categories of workers, no consistency appeared as to which group performed the more difficult tasks or the tasks requiring a high degree of independent judgment.

A total of 97 tasks (23 percent) were performed by 50 percent or more of at least one of the three levels of laboratory workers. Fifty percent or more of the laboratory technicians performed 95 percent of these tasks while only 42 percent were performed by 50 percent or more of the assistants and 48 percent by 50 percent or more of the technologists. These data lead one to suggest that the technicians perform more as generalists in the laboratory while the assistants and technologists are more specialists. This seems to conform to the ideal functional arrangement recommended by the World Health Organization.

The data collected in this study support the conclusion that a strict hierarchy of duties does not exist in the clinical laboratories in hospitals in Duval County, Florida. For well over the majority of tasks, all three educational levels of laboratory workers are performing the same tasks. This is especially the case when the assistants and the technologists are compared, the two groups furthest separated in educational achievement and remunerative compensations. Although the

hospital could financially benefit from such an arrangement by overstaffing with the lower paid assistants, it is questionable as to whether this structure is in the best interest of the patient or is compatible with the emotional and achievement needs of the laboratory worker.

Recommendations

The conclusions resulting from the analysis of data in this study formed the bases for the following recommendations:

1.0 Curriculum Development

1.1 The author recommends that the nucleus for instructional units for each educational category of worker be composed of those tasks that are performed by 50 percent or more of the workers in that category.

1.2 Basic to all three levels of workers should be a thorough knowledge of biochemistry and hematology tasks as well as the duties listed under miscellaneous functions. These three areas appear to encompass the major tasks for all three educational categories of workers.

1.3 The author recommends that those tasks listed in the appendixes which were checked by 50 percent or more of the laboratory workers performing the tasks as being done routinely should be a compulsory part of the curriculum program. Rather less emphasis should be placed on those tasks indicated as being done rarely by 50 percent or more of the workers.

1.4 There were four areas for which 50 percent or more of the workers performing the tasks in these areas indicated on-the-job as the place the majority of these tasks were learned. These

areas were managerial, teaching, miscellaneous, and nuclear laboratory medicine. Therefore, more emphasis should be placed on these areas in the clinical phase of the training of laboratory workers. This applies to all three of the educational levels of workers, since the assistants and the technicians are obviously responsible for a large percentage of the tasks in these areas.

1.5 According to the data collected in this survey, continuing educational programs play an almost negligible part in the training of laboratory workers. It is, therefore, recommended that more opportunities are made available to laboratory workers to supplement their educational programs especially in managerial and teaching areas.

2.0 Laboratory Licensing

2.1 The data collected in this study showed that 16 percent of the laboratory workers are unlicensed. As of now there are no financial provisions allotted by the State of Florida for the inspection of laboratories or for follow-ups on the licensing of laboratory workers. The only inspection done concerning laboratory licensing is in conjunction with Federally sponsored inspection for Medicare and Medicaid participation. The writer recommends that pressure from organized professional laboratory groups be exerted on the State Legislature to allot monies for this purpose.

2.2 When the Florida Licensing Law was put into effect, there was a grandfather clause that allowed licensing without an examination and without careful scrutiny of the qualifications of the applicants. As a result of this study, it was discovered that many assistants and technicians are licensed for positions that, under the requirements of the licensing law, they should not hold. It is, therefore, recommended that provisions be made for yearly relicensing contingent upon certain requirements such as an established number of hours of

continuing educational programs or continuous employment for an established number of months at the position for which the license is held.

3.0 Laboratory Restructuring

3.1 The data collected in this study led to the conclusion that there is a misuse of the three educational categories of workers in the clinical laboratories in hospitals in Duval County. The only way to remedy this problem is through education of the pathologist or director of the laboratory. It is, therefore, recommended that an attempt be made by professional organizations such as the Florida Division of the American Society for Medical Technology or the newly organized TECH-ucation organization (10) to inform the pathologists of the situation as it was discovered in this study and to explain the need and importance of proper manpower utilization in this area.

Suggestions for Further Research

The data collected in this study support the conclusion that the majority of tasks performed in clinical laboratories in hospitals in Duval County are performed by all three educational levels of laboratory workers. No attempt was made to determine if the quality of the work done by the three categories of workers is the same. The author, therefore, recommends that a study be done selecting a certain proportion of each of the three categories of workers and by means of specimens of unknown values to the workers, check the accuracy of their performance on certain laboratory tests.

This study was an attempt to answer six questions set forth in the Statement of Problem. Five of these questions were answered. The last question was: "Does there appear to be a need for three distinct educational levels of medical laboratory workers?" This question for the present will have to go unanswered. It has been concluded that the majority of the duties in the clinical laboratories in hospitals in Duval County are performed by all three educational levels of laboratory workers. If the duties are being performed adequately by all three categories of workers, it would be financially to the advantage of the laboratory and the patient to employ only assistants. This would probably solve any manpower shortage in the laboratory since this category of worker can be trained in a short period of time. If some duties are best carried out by a more thoroughly educated worker, which is the opinion of the author as well as most professionals in the medical laboratory field, then these duties should be the sole responsibility of that category of worker. On the other hand, many of the tasks in the laboratory can adequately be done by a worker with a minimum of training and education. It is a drastic misuse of manpower to have a worker with a high level of education performing these duties. As pointed out by the World Health Organization (24), ideally a hierarchy of duties

should exist in the laboratory for proper utilization of manpower. Before this can be accomplished, the director of the laboratory, usually a pathologist, must be convinced of the importance of clarification of duties and responsibilities within the laboratory.

It is necessary, then, before this last question can be answered as to the need for three distinct educational levels of laboratory workers, that a quality performance check be made on all three categories of workers in the laboratory. Only after this study is completed, could a valid decision be made as to the need for three separate categories of laboratory workers.

APPENDIXES

APPENDIX A

MANAGEMENT FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Assign personnel to duty positions	54	28	52	33	15	6	93	2
2. Assign space for equipment and supplies	63	33	56	33	11	3	87	-
3. Assign specific work to individuals	70	37	59	29	13	3	94	1
4. Coordinate procedures for data processing	15	8	40	47	13	-	87	7
5. Coordinate wage and salary administration program	8	4	75	13	13	-	63	25
6. Assure the availability of equipment and supplies	54	28	70	28	2	2	94	-
7. Coordinate work activities with other laboratory sections	52	27	56	33	12	10	83	2
8. Coordinate work functions of volunteers	9	5	22	67	11	11	56	-
9. Design organization or functional charts	25	13	52	44	4	20	72	8
10. Determine personnel requirements	21	11	52	48	-	14	81	-
11. Develop and/or improve work methods	65	34	32	49	17	11	83	2
12. Develop and/or improve laboratory procedures	61	32	30	56	15	10	80	5

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
13. Develop or revise the organization of the section	40	21	25	50	25	5	88	3
14. Draft budget estimates	10	5	60	40	-	20	70	-
15. Establish organizational policy	15	8	40	47	13	7	87	-
16. Establish performance standards	33	17	45	42	12	27	61	6
17. Establish procedures for special tests	38	20	32	58	11	21	63	8
18. Establish quality control function	55	29	73	22	5	38	56	-
19. Establish research procedures	5	3	40	20	40	20	40	-
20. Establish sanitation standards	15	8	47	40	13	20	67	-
21. Establish work priorities	42	22	55	38	7	10	83	-
22. Formulate standard operating procedures for your lab	31	16	61	35	3	16	77	-
23. Participate in hospital committee functions	21	11	57	29	14	10	81	5
24. Plan and schedule work assignments	43	23	67	21	7	7	86	2
25. Plan record keeping for the section	48	25	60	38	2	8	85	-
26. Plan reports for the section	30	16	53	40	7	17	77	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
27. Plan the maintenance and distribution of reports, records, etc.	28	15	61	36	4	11	86	-
28. Plan work flow	39	21	69	26	5	3	90	-
29. Requisition supplies	74	39	66	27	7	4	91	1
30. Direct the maintenance and utilization of equipment	48	25	71	25	4	8	90	-
31. Direct the maintenance and utilization of supplies	50	26	72	24	4	4	94	-
32. Direct the maintenance and utilization of work space	46	24	85	26	4	9	89	-
33. Direct subordinates in maintaining performance standards	50	26	58	28	14	8	86	4
34. Direct subordinates in the observance of safety practices	48	25	58	29	12	12	79	6
35. Draft and submit job descriptions	14	7	43	43	14	7	64	21
36. Interview and evaluate job candidates	15	8	67	-	33	7	87	7
37. Maintain files of publications	20	11	75	20	5	15	75	5
38. Maintain status boards or charts	17	9	59	35	6	12	82	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
39. Resolve staff complaints	38	20	39	50	11	-	89	5
40. Resolve technical problems	67	35	43	48	9	16	78	-
41. Schedule leaves or passes	25	13	68	28	4	4	92	-
42. Supervise the preparation + maintenance of records + reports	30	16	70	23	7	3	90	-
43. Supervise subordinate supervisor	15	8	67	20	7	7	73	7
44. Evaluate adherence to work schedules	24	13	67	29	4	-	79	-
45. Evaluate compliance with established work standards	21	11	71	29	-	-	62	5
46. Evaluate individuals for promotion and upgrading	21	11	81	14	5	-	95	5
47. Evaluate the accuracy of routine reports	42	22	62	33	5	12	81	-
48. Recommend special corrective action for recurring problems	45	24	42	38	20	64	27	11
49. Resolve personal problems of subordinates	37	19	24	41	35	-	86	8

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
50. Interpret policies and directives	28	15	46	39	14	11	79	7
51. Rotate duty assignments of personnel	29	15	66	48	3	3	72	-
42. Inspect and evaluate adherence to established standards of sanitation, cleanliness + neatness	29	15	59	38	3	17	76	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX B

TEACHING FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Administer written or performance tests	45	24	33	53	13	20	73	-
2. Arrange for teaching aids, space, + equipment	32	17	47	44	9	22	69	3
3. Conduct conferences and classes	23	12	26	52	17	35	61	4
4. Develop curriculum, training materials	24	13	38	63	-	29	54	4
5. Develop on-the-job training materials	28	15	22	68	11	14	68	-
6. Evaluate training effectiveness	29	15	38	38	24	31	55	7
7. Give instruction in accredited education program	30	16	73	23	3	27	60	7
8. Give on-the-job instruction in med. lab. activities	81	43	47	40	14	22	74	2
9. Give training or lectures to non-med. lab. personnel	28	15	25	54	21	32	57	-
10. Orient newly-assigned personnel	55	29	27	62	11	11	84	-
11. Review training progress of individuals	30	16	53	33	13	3	93	-
12. Rotate and assign students	16	8	63	25	13	13	75	6

APPENDIX B—*Continued*

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
13. Schedule on-the-job training	17	9	41	47	12	18	76	-
14. Select and assign instructors	7	4	57	43	-	14	86	-
15. Select individuals for specialized training courses	5	3	20	80	-	20	80	-
16. Select textbooks and library reference material	19	10	26	58	16	32	63	-
17. Show how to locate + interpret technical information	31	16	39	52	10	29	68	-
18. Supervise on-the-job training programs	20	11	45	45	10	10	52	10

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX C

MISCELLANEOUS FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Collect specimens (Blood, urine, skin, etc.) from patients	161	85	77	19	4	63	30	1
2. Prepare and process specimens	147	77	92	6	2	59	34	1
3. Inventory and order supplies	95	50	62	32	6	8	83	-
4. Perform Basal Metabolism Rate (BMR) test	10	5	20	20	60	60	40	-
5. Perform electrocardiogram (EKG) test	33	17	12	30	58	55	40	-
6. Perform preventative maintenance on laboratory equipment	96	51	58	32	9	27	55	6
7. Perform sperm counts	81	43	20	38	42	56	40	1
8. Prepare electrophoresis patterns	52	27	38	21	40	44	46	6
9. Prepare reagents	146	77	59	34	7	53	36	1
10. Prepare specimens for electron microscopy	12	6	33	17	50	50	42	8
11. Prepare specimens for shipment	97	51	42	39	19	20	72	-
12. Prepare specimens for training or reference	52	27	37	40	23	23	65	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
13. Prepare standards	114	60	44	39	11	51	41	1
14. Read electrophoresis patterns	43	23	44	9	47	53	40	2
15. Operate analytical balance	111	58	38	40	23	69	29	2
16. Requisition supplies	89	47	60	28	12	9	82	1
17. Communicate laboratory findings to physicians	145	76	52	43	4	22	68	1
18. Explain laboratory findings to physicians	113	59	26	54	20	37	49	2
19. Explain laboratory task to physicians	94	49	18	51	30	22	64	1
20. Explain laboratory tasks to hospital staff	96	51	21	59	20	18	73	1
21. Explain laboratory tasks to patients	91	48	27	52	22	27	64	-
22. Interpret laboratory functions and policies to hospital personnel or others	77	41	19	62	18	13	77	4
23. Determine equipment repairs or replacements needed	85	45	40	40	20	8	78	4

APPENDIX C—*Continued*

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
24. Initiate reports on unsatisfactory equipment	65	34	37	48	15	5	86	-
25. Handle property turn-in	12	6	67	33	-	-	83	-
26. Log incoming or outgoing specimens	125	66	79	16	5	28	62	1
27. Maintain and revise stock levels	64	34	72	28	-	16	75	-
28. Maintain files of laboratory records or reports	76	40	80	20	-	20	67	-
29. Prepare work orders or work requests	37	19	49	35	16	11	78	-
30. Purchase supplies	28	15	64	29	7	-	89	-
31. Receive incoming supplies	86	45	57	36	7	8	84	-
32. Requisition supplies	73	38	62	32	7	7	84	1
33. Supervise the maintenance of laboratory supplies	41	22	68	24	5	5	83	-
34. Prepare solutions and standards	126	66	61	29	10	50	40	1
35. Perform spinal fluid cell counts	105	55	50	30	19	62	30	1
36. Perform cerebrospinal fluid count	93	49	52	32	16	61	29	1
37. Perform occult blood test	106	56	43	35	22	53	31	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
38. Perform preventive maintenance on laboratory equipment	98	52	64	33	3	31	63	2
39. Calibrate instruments	119	63	50	37	13	45	48	3
40. Assist with autopsy	18	9	6	33	61	61	33	-
41. Establish procedures for special tests	43	23	26	53	21	26	56	5
42. Procure and store biological items	26	14	54	35	15	19	77	-
43. Use crystal and liquid scintillation detectors	16	8	50	31	19	31	63	6
44. Maintain files of laboratory correspondence	25	13	60	28	12	12	68	-
45. Assist in preparation of gross specimens for medical photography	7	4	29	14	57	29	57	-
46. Collect and assemble medical illustration material	6	3	67	17	17	17	83	-
47. Perform genotype of animal blood	1	1	100	-	-	-	100	-
48. Use Geiger-Mueller equipment	8	4	38	25	38	38	63	-

APPENDIX C—*Continued*

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
49. Calculate, evaluate quality control	67	35	55	37	7	42	51	-
50. Assist in research assignments	13	7	15	54	31	38	46	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX D

BIOCHEMISTRY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
1. Do research	7	4	29	57	14	57	43	-
2. Draw blood specimens	136	72	80	15	4	65	32	-
3. Operate automatic analyzers	96	51	67	19	15	47	50	2
4. Operate manometric blood gas apparatus	58	31	40	33	28	48	47	-
5. Operate volumetric blood gas apparatus	42	22	48	21	31	40	52	-
6. Operate chloridometer	47	25	30	38	32	49	49	-
7. Operate chromatography equipment	14	7	57	21	21	43	50	-
8. Operate colorimeter	100	53	74	15	11	68	25	1
9. Operate distillation apparatus	35	18	29	34	37	40	54	3
10. Operate electrophoresis equipment	60	32	38	22	40	52	47	2
11. Operate flame photometer	109	57	63	22	15	55	38	2
12. Operate fluorometer	12	6	42	8	50	25	75	-
13. Operate osmometer	16	8	38	13	50	25	75	-
14. Operate pH meter	91	48	37	35	27	54	44	1

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
15. Operate reflection oximeter	3	2	33	33	33	67	33	-
16. Operate spectrophotometer	99	52	77	15	8	69	27	1
17. Perform acid gel reaction test	2	1	50	50	-	50	50	-
18. Perform acidphosphatase test	89	47	47	30	24	56	28	-
19. Perform serum albumin test	91	48	52	25	23	69	26	-
20. Perform A/G ratio	84	44	43	30	27	65	31	-
21. Perform blood alcohol test	22	12	9	32	59	55	45	-
22. Perform alkaline phosphatase test	95	50	48	31	21	62	35	-
23. Perform alkaloids test	9	5	11	11	78	67	33	-
24. Perform amylase test	110	58	64	24	13	62	32	2
25. Perform barbiturate level test	47	25	26	36	38	49	49	-
26. Perform bilirubin (direct) test	114	60	62	21	17	45	29	1
27. Perform bilirubin (indirect) test	109	57	59	26	16	62	35	-
28. Perform bromosulphalein retention (BSP) test	73	38	48	30	22	70	30	-
29. Perform calcium test	96	51	56	24	20	66	30	1
30. Perform calculus analyses test	36	19	28	31	42	50	44	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
31. Perform carbon dioxide determinations	103	54	63	23	14	58	37	1
32. Perform carbon monoxide determinations	15	8	13	-	93	73	27	-
33. Perform catecholamine test	19	10	26	11	63	53	42	-
34. Perform cephalin flocculations	65	64	40	29	31	68	28	-
35. Perform chlorides test	111	58	61	18	21	66	30	1
36. Perform total cholesteral test	90	47	53	24	22	64	31	-
37. Perform total cholesteral esters test	35	18	14	20	66	54	40	-
38. Perform colloidal gold curve test	38	20	16	34	50	74	24	-
39. Perform steroid studies	23	12	30	30	39	48	52	-
40. Perform creatine test	53	28	42	19	40	60	34	-
41. Perform creatine phosphokinase (CPK) test	82	43	57	21	22	51	45	-
42. Perform serum creatinine test	93	49	55	24	22	68	25	2
43. Perform creatinine clearance test	79	42	49	27	24	58	38	-
44. Perform gastric analysis test (e.g., acidity or Diagnex Blue)	63	33	37	30	33	52	43	-
45. Perform glucose test	115	61	64	22	14	27	30	1

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
46. Perform glucose-6-phosphate dehydrogenase test	39	21	18	33	49	33	64	3
47. Perform glucose tolerance test	100	53	54	28	18	64	31	1
48. Perform serum glutamic oxalacetic transaminase (SGOT) test	88	46	59	20	20	59	38	-
49. Perform serum glutamic pyruvic transaminase (SGPT) test	94	44	54	26	20	60	37	-
50. Perform hormonal steroid assays	20	11	35	25	40	50	45	-
51. Perform icterus index test	50	26	20	26	54	74	20	2
52. Perform insulin tolerance test	24	13	21	33	46	46	54	-
53. Perform lactic dehydrogenase (LDH) test	87	46	56	22	22	63	34	-
54. Perform leucine aminopeptidase (LAP) test	59	58	34	32	34	44	53	-
55. Perform lipase test	79	78	52	20	28	67	30	-
56. Perform lipids profile test	38	20	50	24	26	50	47	-
57. Perform serum magnesium test	27	14	48	19	33	52	44	-
58. Perform nonprotein nitrogen (NPN) test	16	8	13	31	56	69	31	-
59. Perform blood oxyten test	52	27	50	29	21	31	58	4
60. Perform blood pH test	79	42	44	32	24	37	57	3

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
61. Perform phenosulfonphthalein (PSP) excretion test	52	27	23	25	52	63	33	2
62. Perform phosphorus test	85	45	49	26	25	72	25	-
63. Perform potassium determinations	103	54	67	20	13	67	29	1
64. Perform urine prophyrin and/or porphobilinogen test	65	34	29	31	40	63	34	-
65. Perform frog test for pregnancy	18	9	17	28	56	67	33	-
66. Perform slide or tube test for pregnancy	91	48	38	36	20	54	38	2
67. Perform protein bound iodine (PBI) test	40	21	35	25	40	45	55	-
68. Perform total protein test	103	54	52	27	20	64	32	1
69. Perform salicylate level test	85	45	31	38	32	53	42	2
70. Perform sodium determinations	100	53	69	19	12	63	37	-
71. Perform thymol turbidity test	68	36	46	26	28	66	29	-
72. Perform tolbutamide (orinase) tolerance test	11	6	-	9	91	27	73	-
73. Perform blood urea nitrogen (BUN) test	113	59	66	19	14	68	29	-
74. Perform vitamin assays	8	4	38	25	38	38	50	-

		Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
75.	Perform xylose tolerance test	28	15	14	32	50	39	50	4
76.	Perform urinary calcium test	57	30	26	28	46	56	40	2
77.	Perform urine electrolytes test	74	39	27	46	27	57	38	1
78.	Perform urinary chlorides test	52	27	21	38	40	58	37	2
79.	Perform lead test	2	1	-	-	100	50	50	-
80.	Perform noradrenaline studies	2	1	-	50	50	50	50	-
81.	Separate blood from sera	116	61	83	12	5	65	32	2
82.	Supervise biochemistry procedures	24	13	75	25	-	29	67	-
83.	Teach	37	19	51	41	8	35	68	-
84.	Use ashing oven	13	7	31	31	38	46	62	-
85.	Use titrators	41	22	34	34	32	83	17	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing the task.

APPENDIX E

HEMATOLOGY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
1. Do research	6	3	17	50	33	50	50	-
2. Perform bleeding time procedures - Duke method	79	42	34	41	24	73	24	-
3. Prepare and stain blood smears	132	69	73	20	8	71	24	1
4. Perform bone marrow examination	35	19	23	37	40	54	40	3
5. Perform capillary resistance test	37	19	24	22	54	81	14	-
6. Perform chromosomal analysis	2	1	50	50	-	50	50	-
7. Perform clot retraction test	94	49	26	32	43	66	30	-
8. Perform venous whole blood coagulation time tests	110	58	55	30	15	68	28	-
9. Perform cryoglobulin tests	35	18	29	23	49	63	37	-
10. Perform differential cell counts	117	62	68	22	10	74	22	2
11. Perform eosinophile count	88	46	20	34	45	73	23	1
12. Perform erythrocyte fragility tests	62	33	16	27	56	79	18	-
13. Calculate erythrocyte indices	86	45	42	27	31	76	20	1
14. Perform Factor V - VIII - X Assays	20	11	30	25	45	75	20	5

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
15. Perform fibrinogen deficiency test	59	31	31	25	44	63	34	-
16. Perform fibrinolysin test	43	23	21	26	53	74	23	-
17. Perform hematocrit test	128	67	70	22	9	72	24	3
18. Perform hemoglobin test	124	65	69	23	9	73	23	-
19. Prepare lupus erythematosus (L.E.) slides	79	42	34	33	33	70	25	-
20. Microscopically identify lupus erythematosus (L.E.) cells	71	37	37	30	34	77	20	-
21. Identify morphological variations of red or white blood cells	110	58	65	24	12	75	22	2
22. Perform partial thromboplastin time (PTT) test	101	53	52	26	22	60	35	2
23. Stain and read peroxidase stain	31	16	16	19	65	68	32	-
24. Perform platelet count	98	52	52	29	19	71	26	-
25. Perform prothrombin consumption test	49	26	16	33	51	59	33	4
26. Perform prothrombin time test	108	57	64	19	18	71	25	1
27. Perform red blood count	105	55	52	30	17	70	26	-
28. Perform reticulocyte cell count	102	54	47	32	21	75	27	-
29. Perform erythrocyte sedimentation rate	110	58	54	32	15	76	20	1

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
30. Perform sickle cell preparations	106	56	43	35	22	71	25	1
31. Perform spinal fluid cell count	97	51	51	32	18	67	19	1
32. Perform thromboplastin generation tests	34	18	9	24	68	68	24	-
33. Perform white blood counts	115	61	63	23	14	75	23	1
34. Draw capillary or venous bloods	134	71	79	17	4	70	31	1
35. Collect blood specimens for laboratory	133	70	80	17	4	67	29	1
36. Perform petic count	24	13	46	17	38	75	25	-
37. Perform serial thrombin time test	22	12	27	27	45	55	41	5
38. Perform euglobulin test	16	8	13	25	63	50	50	-
39. Stain and read alkaline phosphatase stain	36	19	17	31	56	64	33	-
40. Identify immature blood cells	90	47	47	39	14	73	22	1
41. Determine coagulation time by Lee-White method	117	62	54	34	12	67	29	-
42. Determine coagulation time by capillary method	54	28	33	22	44	70	30	-
43. Perform thrombocyte count	76	40	57	26	17	78	17	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
44. Determine bleeding time - Ivy method	81	43	37	37	26	68	28	-
45. Determine coagulation time by modified Howell method	7	4	43	14	43	71	29	-
46. Operate automatic analyzer for hematology	74	39	62	16	22	43	51	3
47. Operate automatic cell counter	97	51	60	26	14	44	47	6
48. Operate differential cell counter	32	17	56	28	16	56	44	-
49. Operate hemoglobinometer	79	42	52	28	20	58	32	4
50. Operate microhematocrit reader	110	58	55	26	18	65	28	1
51. Supervise hematology procedures	35	18	57	34	9	49	54	3
52. Teach	25	13	36	44	20	36	64	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX F

UROLOGY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
1. Do research	4	3	20	20	60	40	40	-
2. Examine urine specimens macroscopically	123	65	63	27	11	68	26	3
3. Examine urine specimens microscopically	118	62	61	28	11	69	25	1
4. Perform acetone or ketone tests	118	62	61	28	11	65	29	1
5. Perform Addis counts	38	20	8	26	66	76	21	-
6. Perform Bence-Jones protein test	78	41	15	40	45	65	29	-
7. Perform bile test	111	58	50	16	20	68	25	1
8. Perform bilirubin test	82	43	45	32	23	66	24	1
9. Perform concentration test (e.g., Fishberg)	37	19	19	19	62	65	32	-
10. Perform concentration-dilution test (e.g., Mosenthal)	20	11	15	20	65	75	25	-
11. Perform true glucose test	95	50	47	34	19	69	24	1
12. Perform urine hemoglobin test	83	44	49	22	29	64	33	-
13. Perform hemosiderin test	31	16	13	23	65	58	39	-
14. Perform kidney function test	52	27	33	25	42	79	15	-
15. Perform microscopic test for lipids (fats)	39	21	10	28	62	67	31	3

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
16. Perform pH tests	117	62	64	24	12	66	29	1
17. Perform phenylpyruvic acid test	25	13	20	28	52	72	28	-
18. Perform pitressin response concentration test	2	1	50	-	50	100	-	-
19. Perform porphyrins tests	75	39	27	21	52	65	45	-
20. Perform pregnancy test	105	55	51	31	17	68	28	1
21. Perform qualitative urine protein test	91	48	47	32	21	59	36	3
22. Perform urine reducing substance	60	32	55	27	18	68	28	2
23. Perform specific gravity test	115	61	64	26	10	67	28	2
24. Perform toxicological test (e.g., Lead)	5	3	60	-	40	40	60	-
25. Perform uric acid test	39	21	36	28	36	72	21	-
26. Perform urobilinogen test	76	40	25	38	37	67	30	-
27. Perform water loading test (e.g., Soffer)	3	2	33	33	33	100	-	-
28. Supervise urinalysis procedures	25	13	60	36	4	48	52	-
29. Teach	19	10	37	47	16	32	63	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing the task.

APPENDIX G

SEROLOGY AND VIROLOGY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
1. Perform antistreptolysin "0" titers	67	35	34	33	33	70	25	-
2. Perform Strep MG test	7	4	-	14	86	86	-	-
3. Perform anticomplementary retests	10	5	-	30	70	90	-	-
4. Perform cardiolipin microflocculation test	26	14	38	23	38	81	19	-
5. Perform colloidal gold test	49	26	31	24	45	67	29	-
6. Perform complement fixation tests	26	14	12	35	54	80	1	-
7. Perform "C" reactive protein test	71	37	37	31	32	68	28	-
8. Perform febrile agglutination (e.g., Salmonella)	66	35	36	29	35	68	29	-
9. Perform fluorescent treponemal antibody test	9	5	11	11	78	100	-	-
10. Perform hemagglutination test	25	13	20	28	52	76	20	4
11. Perform heterophile presumptive test + differential antibody test	41	22	17	41	41	63	29	-
12. Perform slide agglutination test for mononucleosis	85	45	34	38	27	59	36	1

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
13. Perform latex fixation test	73	38	36	38	26	56	38	1
14. Perform rheumatoid arthritis test (RA)	79	42	37	34	29	59	35	3
15. Perform and read fluorescent antigen-antibody tests	9	5	44	11	44	78	22	-
16. Perform and read skin tests	18	9	44	11	44	61	39	-
17. Perform and read agglutination test (e.g., cold agglutinines)	62	33	37	21	42	65	29	-
18. Perform and read flocculation test (other than for syphilis)	31	16	23	42	35	81	16	-
19. Perform and read precipitation reaction (e.g., agar gel)	18	9	44	28	28	67	28	6
20. Perform thyroid antibody test	20	11	35	40	25	60	40	-
21. Perform VDRL	68	36	34	28	38	62	34	-
22. Prepare antigens	32	17	31	25	44	63	34	-
23. Prepare and read hemolysin reactions	20	11	20	30	50	60	35	-
24. Prepare specimens for virus isolation	8	4	-	13	88	75	25	-
25. Prepare vaccines and sera	3	2	-	33	67	67	33	-
26. Identify viruses and rickettsia	3	2	-	33	67	100	-	-

APPENDIX G—*Continued*

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
27. Perform animal virulence tests	0	-	-	-	-	-	-	-
28. Perform hemagglutination inhibition test	10	5	40	10	50	50	50	-
29. Supervise serology and/or virology procedures	12	6	75	-	25	58	33	-
30. Do research	2	1	-	100	-	-	100	-
31. Teach	13	7	62	15	23	38	46	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX H

PARASITOLOGY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Do research	4	2	25	25	50	50	25	-
2. Examine specimens macroscopically	64	34	42	34	23	77	19	-
3. Examine specimens microscopically	73	38	44	32	25	79	14	-
4. Identify parasitic and disease carrying arthropods	24	13	25	29	46	79	17	-
5. Identify parasites microscopically or macroscopically	63	33	32	40	29	87	10	-
6. Maintain parasite cultures	6	3	50	33	17	83	17	-
7. Perform concentration and flotation techniques	67	35	34	34	31	73	22	-
8. Perform microfilarial examinations	25	13	24	20	56	92	4	-
9. Perform serological test for parasites	10	5	30	10	60	70	30	-
10. Stain parasitological smears	34	18	29	26	44	82	15	-
11. Stain and read malaria smears	58	31	16	33	52	81	14	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
12. Supervise parasitology procedures	19	10	47	37	16	47	47	-
13. Teach	13	7	31	54	15	62	38	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX I

MYCOLOGY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Collect skin specimens directly from patients	30	16	3	23	73	67	27	-
2. Cultivate mycology specimens for primary isolation	38	20	45	29	26	66	29	-
3. Do research	1	1	-	-	100	-	100	-
4. Identify and classify fungi	29	15	17	17	66	76	17	-
5. Maintain stock cultures	13	7	38	38	23	62	23	-
6. Perform KOH preparation for dermatophytes	29	15	3	38	59	66	28	-
7. Prepare culture media	30	16	13	33	53	57	33	-
8. Stain mycology specimens	26	14	23	23	54	81	15	-
9. Supervise mycology procedures	7	4	29	29	43	71	29	-
10. Teach	5	3	60	20	20	60	20	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX J

NUCLEAR LABORATORY MEDICINE FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Assist in preparing and counting samples	27	14	48	22	30	44	56	-
2. Conduct test for presence and measurement of radioactivity	19	10	53	32	16	47	53	-
3. Count body fluid specimens	19	10	47	32	21	32	63	5
4. Dispose of radioactive wastes	16	8	56	13	31	25	63	-
5. Do research	0	-	-	-	-	-	-	-
6. Maintain safety standards	14	7	86	7	7	36	64	-
7. Modify standard lab. equipment + techniques to measure radioactivity	4	2	75	25	-	50	50	-
8. Perform organ scans and/or images	7	4	43	29	29	29	57	-
9. Perform autoradiography	1	1	-	-	100	100	-	-
10. Record and summarize data	7	4	86	-	14	29	71	-
11. Segregate and prepare radioactive specimens for measurement of radioactivity	9	5	78	11	11	44	56	-
12. Supervise radioactivity procedures	7	4	100	-	-	14	71	14

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
13. Teach	9	5	22	56	22	-	100	-
14. Use radioisotope measurement instruments	15	8	60	27	13	40	53	7

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing tasks.

APPENDIX K

BACTERIOLOGY FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Assist in epidemiological investigations	15	8	33	27	40	33	53	7
2. Clean area and equipment aseptically	51	27	47	37	16	53	37	-
3. Collect specimens directly from patient	63	33	19	46	34	73	25	-
4. Do research	7	4	14	43	43	71	29	-
5. Examine specimens microscopically	48	25	65	33	25	94	21	-
6. Identify and classify bacteria	54	28	52	24	24	80	15	-
7. Identify bacteria morphologically	56	29	54	27	16	73	18	-
8. Inoculate media for biochemical tests	59	31	56	27	17	78	17	-
9. Maintain stock cultures	38	20	61	21	18	68	21	-
10. Make smears for microscopic examination	93	49	48	32	29	71	26	-
11. Perform animal inoculations	7	4	-	14	86	86	14	-
12. Perform animal virulence test	3	2	-	33	67	100	-	-
13. Perform bacteriological examinations of food products	10	5	-	10	90	60	30	-
14. Perform bacteriological examinations of sewage	4	2	-	25	75	75	25	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
15. Perform bacteriological examinations of water	10	5	-	30	70	80	20	-
16. Perform fluorescent antibody studies	7	4	14	43	43	86	14	-
17. Perform initial planting of cultures	78	41	60	26	14	77	19	-
18. Perform special staining (i.e., T.B., Diphtheria)	46	24	43	33	24	87	9	-
19. Perform serological identification of bacteria	41	22	34	34	32	76	20	-
20. Prepare antigens	12	6	8	50	42	75	25	-
21. Plant organisms for sensitivity studies	54	28	61	24	15	70	24	-
22. Prepare autogenous vaccines	3	2	-	33	67	33	67	-
23. Prepare culture media	48	25	42	38	21	67	25	-
24. Process T.B. specimens for inoculation	28	15	50	32	18	68	25	-
25. Read antibiotic sensitivity tests	44	23	61	23	16	57	32	3
26. Read results of biochemical tests	46	24	59	20	22	70	24	-
27. Stain smears for microscopic examination	80	42	41	38	21	76	18	1

APPENDIX K—*Continued*

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
28. Streak plates	90	47	57	27	17	72	28	-
29. Supervise bacteriology procedures	17	9	65	24	12	47	41	-
30. Teach	17	9	65	24	12	47	41	-
31. Use anaerobic devices	49	26	43	35	22	59	35	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX L

BLOOD BANK FUNCTIONS

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Accumulate and maintain blood bank statistics	20	11	65	20	15	25	65	-
2. Attach serial numbers to units	14	7	43	36	21	57	43	-
3. Calibrate centrifuges	11	6	27	36	36	64	36	-
4. Centrifuge and separate serum from clot	44	23	66	18	16	61	34	-
5. Check and record temperatures of refrigerators +/or alarms	36	19	53	28	19	50	44	-
6. Crossmatch blood	34	18	59	21	21	68	26	-
7. Dispose of unused blood after expiration time limit	23	12	35	26	39	61	35	-
8. Do research	3	2	-	67	33	100	-	-
9. Do syphilis serology	36	19	39	39	22	75	19	-
10. Draw blood from donors	19	10	21	37	42	58	42	-
11. Draw patient's blood for grouping, typing, + cross-match	93	49	63	28	9	65	29	1
12. Maintain blood inventory (e.g., count number of bottles on hand)	31	16	48	32	16	48	45	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
13. Maintain donor files	16	8	56	19	25	38	56	-
14. Maintain files of blood banking forms including labels	13	7	69	15	15	31	62	-
15. Order blood by phone from suppliers	62	33	50	31	19	31	60	2
16. Order and maintain reagents and supplies	19	10	63	16	21	26	68	-
17. Organize and store blood	34	18	44	38	18	26	68	3
18. Perform absorption technique	21	11	24	14	62	62	29	-
19. Perform antibody screen and identification tests	33	17	48	21	30	61	30	-
20. Perform antibody titers (dilutions)	26	14	27	35	38	62	31	-
21. Perform direct and indirect Coombs test	58	31	36	33	31	69	24	-
22. Perform elution technique	19	10	32	16	53	84	16	-
23. Perform first aid for shock	13	7	-	38	62	54	46	-
24. Perform genotype of blood	26	14	27	15	58	62	35	-
25. Perform transfusion reaction studies	31	16	32	29	39	65	29	-
26. Prepare blood for shipment	20	11	30	35	35	40	55	-
27. Prepare and read slide agglutinations reactions	41	22	46	29	24	68	20	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
28. Prepare and read tube agglutinations reactions	38	20	53	24	24	74	18	-
29. Prepare controls	13	7	54	15	31	69	23	-
30. Prepare special blood fractions (e.g. platelet rich blood)	10	5	30	20	50	80	20	-
31. Process blood for packed cells	27	14	44	22	26	52	41	-
32. Record information on blood record card	24	13	63	17	21	46	50	-
33. Screen and schedule donors	12	6	25	33	42	67	33	-
34. Store +/or dispose of used blood containers and pilot tubes	19	10	47	42	11	53	47	-
35. Supervise blood bank procedures	11	6	64	36	-	36	55	-
36. Take blood of donor for hemoglobin concentration	9	5	33	11	56	56	44	-
37. Take blood pressure of donors +/or pulse rate	11	6	27	18	55	64	36	-
38. Teach	6	3	17	33	50	50	33	-
39. Test blood for ABO grouping and ABO subgrouping	58	31	45	29	26	74	22	-

	Total Performing Task	Percent*	Task Performed Percent**			Task Learned Percent**		
			Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
40. Test blood for Rh or Du factors	59	31	44	27	29	75	20	-
41. Use refrigerated centrifuge	10	5	30	10	60	60	40	-

*Percentage of total number of workers responding to survey (190).

**Percentage of total number of workers performing task.

APPENDIX M—SURVEY QUESTIONNAIRE

Name _____

The purpose of this study is to obtain information on specific tasks performed in a clinical laboratory. The identity of the person answering the questionnaire is not important to the study. The researcher will identify the individual only as necessary to insure complete returns with no duplications. Results from the study will appear only in statistical tables and summary statements. Only geographic area will be identified in any report or publication.

This questionnaire is divided into three parts. Please read the directions for each part.

DIRECTIONS

PART I

Part I contains general background information. Please answer all questions by filling in the blank or by circling the letter of the appropriate response.

PART II

Part II of the task analysis survey concerns managerial, teaching, and miscellaneous functions. Please go through *all* three sections checking the tasks that you perform if any. For all those tasks that you check, place a check mark in the box that indicates how frequently you perform this task (routinely, occasionally, rarely) and a check in the box under where you learned to perform the task (in school, on-the-job, in a continuing education program).

PART III

Part III concerns laboratory area tasks questions. Obtain the questionnaire form on the laboratory *area* (Bacteriology, Blood Bank, Biochemistry, Hematology, Mycology, Parasitology, Nuclear Laboratory Medicine, Serology and Virology, Urology) or *areas* in which you work regardless of how rarely you may work in that area. Check all the tasks that you perform. For all those tasks that you check, place a check mark in the box that indicates how frequently you perform this task and where you learned to perform the task.

PART I

1. Age _____

2. Marital Status

   a. Married c. Divorced

   b. Single d. Widowed

3. Sex a. Male b. Female

4. Length of time employed in this institution _____

5. Length of time employed in a medical laboratory profession _____

6. Employment a. Full-time b. Part-time

7. Licensed in Florida as:

   a. Laboratory Assistant d. Supervisor

   b. Laboratory Technician e. Laboratory Director

   c. Medical Technologist f. Not licensed in Fla.

8. Certified or registered as: (circle one or ones which apply)

   a. Medical Technologist (ASCP)

   b. Medical Laboratory Technician (ASCP)

   c. Certified Laboratory Assistant (ASCP)

   d. Medical Technologist (AMT)

   e. Clinical Chemist (National Registry in Clin. Chem.)

   f. Chemistry Technologist (National Registry in Clin. Chem.)

   g. Specialist in Chemistry (ASCP)

   h. Certificate in Blood Banking (BB, ASCP)

i. Specialist in Microbiology (ASCP)

j. Certificate in Microbiology (American Society of Microbiology)

k. Nuclear Medical Technologist (ASCP)

l. Nuclear Medical Technologist (ARRT)

m. Other (specify) _____

n. No certification or registration held

9. Highest level of formal education:

a. Less than high school graduate

b. High school graduate

c. Less than 2 years of college

d. 2 to 4 years college (includes Associate degree)

e. Bachelor's degree (Major subject) _____

f. Master's Degree (Major subject) _____

g. Doctorate degree (Major subject) _____

h. Other (Specify) _____

10. Type of *medical laboratory* training you have had:

a. None

b. On-the-job

c. Proprietary laboratory school

d. Laboratory school in military service

e. Junior college or vocational-technical center

f. ASCP approved school

g. AABB approved blood bank training

h. Other (Specify)

11. Area of your major responsibilities (circle one or more)

a. Bacteriology
b. Biochemistry
c. Serology
d. Hematology
e. Mycology
f. Parasitology
g. Virology
h. Urology
i. Blood Bank
j. Nuclear Medicine
k. General (Rotate)
l. Other (Specify) _____

12. Yearly salary

a. Less than 4,000
b. 4,000 - 4,799
c. 4,800 - 5,399
d. 5,400 - 5,999
e. 6,000 - 6,599
f. 6,600 - 7,199
g. 7,200 - 7,799
h. 7,800 - 11,999
i. 12,000 or more

13. Which of the titles listed below most nearly describes your present position?

a. Laboratory Assistant
b. Trainee or Student
c. Laboratory Technician
d. Medical Technologist
e. Section Supervisor
f. Assistant Section Supervisor
g. Teaching Supervisor
h. Chief Technologist
i. Laboratory Director

14. Do you have an immediate supervisor or pathologist who is available for consultation?

a. Yes b. No

If yes, is he:

a. In lab at all time

b. Available when needed

c. Available by phone

d. Not always available when needed

15. Do you feel you have the responsibility to use independent judgment in the performance of your duties?

a. Yes b. No

16. Do you work under the supervision of another laboratory worker or supervisor?

a. Yes b. No

If yes, which of the following best represents *his* position?

a. Medical Laboratory Technician

b. Medical Technologist

c. Assistant Section Supervisor

d. Section Supervisor

e. Chief Technologist

f. Director or Pathologist

PART II

MANAGERIAL, TEACHING, AND MISCELLANEOUS FUNCTIONS

Management	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Assign personnel to duty positions							
2. Assign space for equipment and supplies							
3. Assign specific work to individuals							
4. Coordinate procedures for data processing							
5. Coordinate wage and salary administration program							
6. Assure the availability of equipment and supplies							
7. Coordinate work activities with other laboratory sections							
8. Coordinate work functions of volunteers							
9. Design organization or functional charts							
10. Determine personnel requirements							
11. Develop and/or improve work methods							
12. Develop and/or improve laboratory procedures							
13. Develop or revise the organization of the section							
14. Draft budget estimates							
15. Establish organizational policy							

PART II—*Continued*

Management	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
16. Establish performance standards							
17. Establish procedures for special tests							
18. Establish quality control function							
19. Establish research procedures							
20. Establish sanitation standards							
21. Establish work priorities							
22. Formulate standard operating procedures for your lab							
23. Participate in hospital committee functions							
24. Plan and schedule work assignments							
25. Plan record keeping for the section							
26. Plan reports for the section							
27. Plan the maintenance and distribution of reports, records, etc.							
28. Plan work flow							
29. Requisition supplies							
30. Direct the maintenance and utilization of equipment							
31. Direct the maintenance and utilization of supplies							

PART II—*Continued*

Management	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
32. Direct the maintenance and utilization of work space							
33. Direct subordinates in maintaining performance standards							
34. Direct subordinates in the observance of safety practices							
35. Draft and submit job descriptions							
36. Interview and evaluate job candidates							
37. Maintain files of publications							
38. Maintain status boards or charts							
39. Resolve staff complaints							
40. Resolve technical problems							
41. Schedule leaves or passes							
42. Supervise the preparation + maintenance of records + reports							
43. Supervise subordinate supervisor							
44. Evaluate adherence to work schedules							
45. Evaluate compliance with established work standards							

PART II—*Continued*

Management	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
46. Evaluate individuals for promotion and upgrading							
47. Evaluate the accuracy of routine reports							
48. Recommend special corrective action for recurring problems							
49. Resolve personal problems of subordinates							
50. Interpret policies and directives							
51. Rotate duty assignments of personnel							
52. Inspect and evaluate adherence to established standards of sanitation, cleanliness + neatness							
Please list any tasks done by you in this area which are not listed.							

PART II

Teaching	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Administer written or performance tests							
2. Arrange for teaching aids, space, + equipment							
3. Conduct conferences and classes							
4. Develop curriculum, training materials							
5. Develop on the job training materials							
6. Evaluate training effectiveness							
7. Give instruction in accredited education program							
8. Give on-the-job instruction in med. lab. activities							
9. Give training or lectures to non-med. lab. personne.							
10. Orient newly-assigned personnel							
11. Review training progress of individuals							
12. Rotate and assign students							
13. Schedule on-the-job training							
14. Select and assign instructors							
15. Select individuals for specialized training courses							

PART II—*Continued*

Teaching	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
16. Select textbooks and library reference material							
17. Show how to locate + interpret technical information							
18. Supervise on-the-job training programs							
Please list any tasks done by you in this area which are not listed.							

PART II

Miscellaneous	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
1. Collect specimens (Blood, urine, skin, etc.) from patients							
2. Prepare and process specimens							
3. Inventory and order supplies							
4. Perform Basal Metabolism Rate (BMR) test							
5. Perform electrocardiogram (EKG) test							
6. Perform preventative maintenance on laboratory equipment							
7. Perform sperm counts							
8. Prepare electrophoresis patterns							
9. Prepare reagents							
10. Prepare specimens for electron microscopy							
11. Prepare specimens for shipment							
12. Prepare specimens for training or reference							
13. Prepare standards							
14. Read electrophoresis patterns							
15. Operate analytical balance							
16. Requisition supplies							
17. Communicate laboratory findings to physicians							

PART II—*Continued*

Miscellaneous	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
18. Explain laboratory findings to physicians							
19. Explain laboratory task to physicians							
20. Explain laboratory tasks to hospital staff							
21. Explain laboratory tasks to patients							
22. Interpret laboratory functions and policies to hospital personnel or others							
23. Determine equipment repairs or replacements needed							
24. Initiate reports on unsatisfactory equipment							
25. Handle property turn-in							
26. Log incoming or outgoing specimens							
27. Maintain and revise stock levels							
28. Maintain files of laboratory records or reports							
29. Prepare work orders or work requests							
30. Purchase supplies							
31. Receive incoming supplies							
32. Requisition supplies							
33. Supervise the maintenance of laboratory supplies							
34. Prepare solutions and standards							

PART II—*Continued*

Miscellaneous	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
35. Perform spinal fluid cell counts							
36. Perform cerebrospinal fluid count							
37. Perform occult blood test							
38. Perform preventive maintenance on laboratory equipment							
39. Calibrate instruments							
40. Assist with autopsy							
41. Establish procedures for special tests							
42. Procure and store biological items							
43. Use crystal and liquid scintillation detectors							
44. Maintain files of laboratory correspondence							
45. Assist in preparation of gross specimens for medical photography							
46. Collect and assemble medical illustration material							
47. Perform genotype of animal blood							
48. Use Geiger-Mueller equipment							
49. Calculate, evaluate quality control							

PART II—*Continued*

Miscellaneous	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
50. Assist in research assignments Please list any tasks done by you in this area which are not listed							

PART III

Biochemistry	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-job	Cont. Educ.
1. Do research							
2. Draw blood specimens							
3. Operate automatic analyzers							
4. Operate manometric blood gas apparatus							
5. Operate volumetric blood gas apparatus							
6. Operate chloridometer							
7. Operate chromatography equipment							
8. Operate colorimeter							
9. Operate distillation apparatus							
10. Operate electrophoresis equipment							
11. Operate flame photometer							
12. Operate fluorometer							
13. Operate osmometer							
14. Operate pH meter							
15. Operate reflection oximeter							
16. Operate spectrophotometer							
17. Perform acid gel reaction test							
18. Perform acid phophatase test							

PART III—*Continued*

Biochemistry	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
19. Perform serum albumin test							
20. Perform A/G ratio							
21. Perform blood alcohol test							
22. Perform alkaline phosphatase test							
23. Perform alkaloids test							
24. Perform amylase test							
25. Perform barbiturate level test							
26. Perform bilirubin (direct) test							
27. Perform bilirubin (indirect) test							
28. Perform bromosulphalein retention (BSP) test							
29. Perform calcium test							
30. Perform calculus analyses test							
31. Perform carbon dioxide determinations							
32. Perform carbon monoxide determinations							
33. Perform catecholamine test							
34. Perform cephalin flocculations							
35. Perform chlorides test							

PART III—*Continued*

Biochemistry	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
36. Perform total cholesteral test							
37. Perform total cholesteral esters test							
38. Perform colloidal gold curve test							
39. Perform steroid studies							
40. Perform creatine test							
41. Perform creatine phosphokinase (CPK) test							
42. Perform serum creatinine test							
43. Perform creatinine clearance test							
44. Perform gastric analysis test (e.g., acidity or Diagnex Blue)							
45. Perform glucose test							
46. Perform glucose-6-phosphate dehydrogenase test							
47. Perform glucose tolerance test							
48. Perform serum glutamix oxalacetic transaminase (SGOT) test							
49. Perform serum glutamic pyruvic transaminase (SGPT) test							
50. Perform hormonal steroid assays							

PART III—*Continued*

Biochemistry	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
51. Perform icterus index test							
52. Perform insulin tolerance test							
53. Perform lactic dehydrogenase (LDH) test							
54. Perform leucine aminopeptidase (LAP) test							
55. Perform lipase test							
56. Perform lipids profile test							
57. Perform serum magnesium test							
58. Perform non-protein nitrogen (NPN) test							
59. Perform blood oxygen test							
60. Perform blood pH test							
61. Perform phenosulfonphthalein (PSP excretion test							
62. Perform phosphorus test							
63. Perform potassium determinations							
64. Perform urine prophyrin and/or porphobilinogen test							
65. Perform frog test for pregnancy							
66. Perform slide or tube test for pregnancy							
67. Perform protein bound iodine (PBI) test							

PART III—*Continued*

Biochemistry	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
68. Perform total protein test							
69. Perform salicylate level test							
70. Perform sodium determinations							
71. Perform thymol turbidity test							
72. Perform tolbutamide (orinase) tolerance test							
73. Perform blood urea nitrogen (BUN) test							
74. Perform vitamin assays							
75. Perform xylose tolerance test							
76. Perform urinary calcium test							
77. Perform urine electrolytes test							
78. Perform urinary chlorides test							
79. Perform lead test							
80. Perform noradrenaline studies							
81. Separate blood from sera							
82. Supervise biochemistry procedures							
83. Teach							

PART III—*Continued*

Biochemistry	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
84. Use ashing oven							
85. Use titrators							
Please list any tasks done by you in this area which are not listed.							

PART III

Hematology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Do research							
2. Perform bleeding time procedures - Duke method							
3. Prepare and stain blood smears							
4. Perform bone marrow examination							
5. Perform capillary resistance test							
6. Perform chromosomal analysis							
7. Perform clot retraction test							
8. Perform venous whole blood coagulation time tests							
9. Perform cryoglobulin tests							
10. Perform differential cell counts							
11. Perform eosinophile count							
12. Perform erythrocyte fragility tests							
13. Calculate erythrocyte indices							
14. Perform Factor V - VIII - X Assays							
15. Perform fibrinogen deficiency							
16. Perform fibrinolysin test							
17. Perform hematocrit test							

PART III—*Continued*

Hematology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
18. Perform hemoglobin test							
19. Prepare lupus erythematosus (L.E.) slides							
20. Microscopically identify lupus erythematosus (L.E.) cells							
21. Identify morphological variations of red or white blood cells							
22. Perform partial thromboplastin time (PTT) test							
23. Stain and read peroxidase stain							
24. Perform platelet count							
25. Perform prothrombin consumption test							
26. Perform prothrombin time test							
27. Perform red blood count							
28. Perform reticulocyte cell count							
29. Perform erythrocyte sedimentation rate							
30. Perform sickle cell preparations							
31. Perform spinal fluid cell count							
32. Perform thromboplastin generation tests							
33. Perform white blood counts							

PART III—*Continued*

Hematology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
34. Draw capillary or venous bloods							
35. Collect blood specimens for laboratory							
36. Perform petic count							
37. Perform serial thrombin time test							
38. Perform euglobulin test							
39. Stain and read alkaline phosphatase stain							
40. Identify immature blood cells							
41. Determine coagulation time by Lee-White method							
42. Determine coagulation time by capillary method							
43. Perform thrombocyte count							
44. Determine bleeding time - Ivy method							
45. Determine coagulation time by modified Howell method							
46. Operate automatic analyzer for hematology							
47. Operate automatic cell counter							
48. Operate differential cell counter							
49. Operate hemoglobinometer							

PART III—*Continued*

Hematology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
50. Operate microhematocrit reader							
51. Supervise hematology procedures							
52. Teach							
Please list any tasks done by you in this area which are not listed.							

PART III

Urology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Do research							
2. Examine urine specimens macroscopically							
3. Examine urine specimens microscopically							
4. Perform acetone or ketone tests							
5. Perform Addis counts							
6. Perform Bence-Jones protein test							
7. Perform bile test							
8. Perform bilirubin test							
9. Perform concentration test (e.g., Fishberg)							
10. Perform concentration-dilution test (e.g., Mosenthal)							
11. Perform true glucose test							
12. Perform urine hemoglobin test							
13. Perform hemosiderin test							
14. Perform kidney function test							
15. Perform microscopic test for lipids (fats)							
16. Perform pH tests							
17. Perform phenylpyruvic acid test							

PART III—*Continued*

Urology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
18. Perform pitressin response concentration test							
19. Perform porphyrins tests							
20. Perform pregnancy test							
21. Perform qualitative urine protein test							
22. Perform urine reducing substance							
23. Perform specific gravity test							
24. Perform toxicological test (e.g., Lead)							
25. Perform uric acid test							
26. Perform urobilinogen test							
27. Perform water loading test (e.g., Soffer)							
28. Supervise urinalysis procedures							
29. Teach							
Please list any tasks done by you in this area which are not listed.							

PART III

Serology and Virology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Perform antistreptolysin "O" titers							
2. Perform Strep MG test							
3. Perform anticomplementary retests							
4. Perform cardiolipin microflocculation test							
5. Perform colloidal gold test							
6. Perform complement fixation tests							
7. Perform "C" reactive protein test							
8. Perform febrile agglutination (e.g., Salmonella)							
9. Perform fluorescent treponemal antibody test							
10. Perform hemagglutination test							
11. Perform heterophile presumptive test + differential antibody test							
12. Perform slide agglutination test for mononucleosis							
13. Perform latex fixation test							
14. Perform rheumatoid arthritis test (RA)							
15. Perform and read fluorescent antigen-antibody tests							
16. Perform and read skin tests							

PART III—*Continued*

Serology and Virology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
17. Perform and read agglutination test (e.g., cold agglutinines)							
18. Perform and read flocculation test (other than for syphilis)							
19. Perform and read precipitation reaction (e.g., agar gel)							
20. Perform thyroid antibody test							
21. Perform VDRL							
22. Prepare antigens							
23. Prepare and read hemolysin reactions							
24. Prepare specimens for virus isolation							
25. Prepare vaccines and sera							
26. Identify viruses and rickettsia							
27. Perform animal virulence tests							
28. Perform hemagglutination inhibition test							
29. Supervise serology and/or virology procedures							
30. Do research							
31. Teach							
Please list any tasks done by you in this area which are not listed.							

PART III

Parasitology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Do research							
2. Examine specimens macroscopically							
3. Examine specimens microscopically							
4. Identify parasitic and disease carrying arthropods							
5. Identify parasites microscopically or macroscopically							
6. Maintain parasite cultures							
7. Perform concentration and flotation techniques							
8. Perform microfilarial examinations							
9. Perform serological test for parasites							
10. Stain parasitological smears							
11. Stain and read malaria smears							
12. Supervise parasitology procedures							
13. Teach							
Please list any tasks done by you in this area which are not listed.							

PART III

Mycology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Collect skin specimens directly from patients							
2. Cultivate mycology specimens for primary isolation							
3. Do research							
4. Identify and classify fungi							
5. Maintain stock cultures							
6. Perform KOH preparation for dermatophytes							
7. Prepare culture media							
8. Stain mycology specimens							
9. Supervise mycology procedures							
10. Teach							
Please list any tasks done by you in this area which are not listed.							

PART III

Nuclear Laboratory Medicine	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Assist in preparing and counting samples							
2. Conduct test for presence and measurement of radioactivity							
3. Count body fluid specimens							
4. Dispose of radioactive wastes							
5. Do research							
6. Maintain safety standards							
7. Modify standard lab. equipment + techniques to measure radioactivity							
8. Perform organ scans and/or images							
9. Perform autoradiography							
10. Record and summarize data							
11. Segregate and prepare radioactive specimens for measurement of radioactivity							
12. Supervise radioactivity procedures							
13. Teach							
14. Use radioisotope measurement instruments							
Please list any tasks done by you in this area which are not listed.							

PART III

Bacteriology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Assist in epidemiological investigations							
2. Clean area and equipment aseptically							
3. Collect specimens directly from patient							
4. Do research							
5. Examine specimens microscopically							
6. Identify and classify bacteria							
7. Identify bacteria morphologically							
8. Inoculate media for biochemical tests							
9. Maintain stock cultures							
10. Make smears for microscopic examination							
11. Perform animal inoculations							
12. Perform animal virulence test							
13. Perform bacteriological examinations of food products							
14. Perform bacteriological examinations of sewage							
15. Perform bacteriological examinations of water							
16. Perform fluorescent antibody studies							

PART III—*Continued*

Bacteriology	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
17. Perform initial planting of cultures							
18. Perform special staining (i.e., T.B., Diphtheria)							
19. Perform serological identification of bacteria							
20. Prepare antigens							
21. Plant organisms for sensitivity studies							
22. Prepare autogenous vaccines							
23. Prepare culture media							
24. Process T.B. specimens for inoculation							
25. Read antibiotic sensitivity tests							
26. Read results of biochemical tests							
27. Stain smears for microscopic examination							
28. Streak plates							
29. Supervise bacteriology procedures							
30. Teach							
31. Use anaerobic devices							
Please list any tasks done by you in this area which are not listed.							

PART III

Blood Bank	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
1. Accumulate and maintain blood bank statistics							
2. Attach serial numbers to units							
3. Calibrate centrifuges							
4. Centrifuge and separate serum from clot							
5. Check and record temperatures of refrigerators +/or alarms							
6. Crossmatch blood							
7. Dispose of unused blood after expiration time limit							
8. Do research							
9. Do syphilis serology							
10. Draw blood from donors							
11. Draw patient's blood for grouping, typing, + cross-match							
12. Maintain blood inventory (e.g., count number of bottles on hand)							
13. Maintain donor files							
14. Maintain files of blood banking forms including labels							

PART III—*Continued*

Blood Bank	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
15. Order blood by phone from suppliers							
16. Order and maintain reagents and supplies							
17. Organize and store blood							
18. Perform absorption technique							
19. Perform antibody screen and identification tests							
20. Perform antibody titers (dilutions)							
21. Perform direct and indirect Coombs tests							
22. Perform elution technique							
23. Perform first aid for shock							
24. Perform genotype of blood							
25. Perform transfusion reaction studies							
26. Prepare blood for shipment							
27. Prepare and read slide agglutinations reactions							
28. Prepare and read tube agglutinations reactions							
29. Prepare controls							

Blood Bank	Task Done	Task Performed			Task Learned		
		Routinely	Occasionally	Rarely	School	On-the-Job	Cont. Educ.
30. Prepare special blood fractions (e.g., platelet rich blood)							
31. Process blood for packed cells							
32. Record information on blood record card							
33. Screen and schedule donors							
34. Store +/or dispose of used blood containers and pilot tubes							
35. Supervise blood bank procedures							
36. Take blood of donor for hemoglobin concentration							
37. Take blood pressure of donors +/or pulse rate							
38. Teach							
39. Test blood for ABO grouping and ABO subgrouping							
40. Test blood for RH or Du factors							
41. Use refrigerated centrifuge							
Please list any tasks done by you in this area which are not listed.							

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BIOGRAPHICAL SKETCH

Clare Crabtree Bailey was born on May 28, 1945, in Washington, D. C. She was graduated from Robert E. Lee High School in Jacksonville, Florida, in June, 1963. She attended Emory University in Atlanta, Georgia, for two years, then transferred to the University of Florida where she received in April, 1967, the degree of Bachelor of Science in Medical Technology with high honors. In May, 1967, she entered the Graduate School of the University of Florida in bacteriology. She received the degree of Master of Science in August of 1969. She then entered the Graduate School of the University of Florida in educational administration where she had since pursued her work toward the degree of Doctor of Philosophy.

She is a member of the American Society of Medical Technologists, Phi Kappa Phi Honorary Society, Eta Rho Pi health-related honorary fraternity, and Pi Lambda Theta honorary and professional educational association for women. She also holds membership in the Schools of Allied Health Professions and the Florida TECH-ucation society.

Clare Crabtree Bailey is married to Donald Ryan Bailey. They live in Jacksonville, Florida, and are the parents of two children. She is an ASCP registered Medical Technologist, licensed in Florida.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Professor of Educational
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